ON THE COVER

MORE gold has been produced and more dividends (in excess of $126,000,000) have been paid by Hollinger Consolidated Gold Mines Limited than by any other Canadian gold mine. Its main property at Timmins, Ont., has been developed by means of four shafts and many miles of underground workings that reach an extreme depth exceeding 5100 feet. Its mill can treat 5000 tons of ore daily. Employees now number around 2300 and have ranged above 3000 during more favorable gold-mining eras. A subsidiary company is now engaged, together with the M. A. Hanna interests of Cleveland, Ohio, in opening up Labrador iron deposits. Our cover picture shows the surface plant at Timmins, with a baseball park and other employee recreational facilities in the foreground.

•

IN THIS ISSUE

AMONG the anomalies of our times are the divergent policies of governmental price controls. While prices of agricultural products are held up to artificial levels, that of gold is held down to a figure that is just as fictitious. Sooner or later, of course, the fundamental law of supply and demand will have to be allowed to assert itself. That is why the quest for gold goes on unabated, spurred by an age-old human desire that is discussed in our leading article.

•

AIR power is so adaptable that the average industrial plant using it for one or more specific purposes usually finds additional services that it can perform advantageously. The article that starts on Page 7 describes its manifold applications at the Los Angeles factory of Emsco Derrick & Equipment Company.

•

HOW a seeming jumble of heavy construction equipment crowded into a small space can be made to function with orderly efficiency on a building foundation job is told in the article *Half an Acre of Planned Confusion*. Page 10.

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THE article that starts on Page 16 tells how a compressor booster station on a Texas natural-gas line acts almost without human attention to maintain the desired delivery of fuel despite hour-to-hour fluctuation in demand.

Compressed Air Magazine

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ANNA M. HOFFMANN, *Associate Editor* J. J. KATARBA, *Advertising Mgr.*
A. W. LOOMIS, *Assistant Editor* JOSEPH C. DILTS, *Advertising Sales*
WALTER P. GILLINGHAM, *Assistant Editor*
D. Y. MARSHALL, *Europe*, 243 Upper Thames St., London, E. C. 4.
F. A. McLEAN, *Canada*, New Birks Building, Montreal, Quebec.

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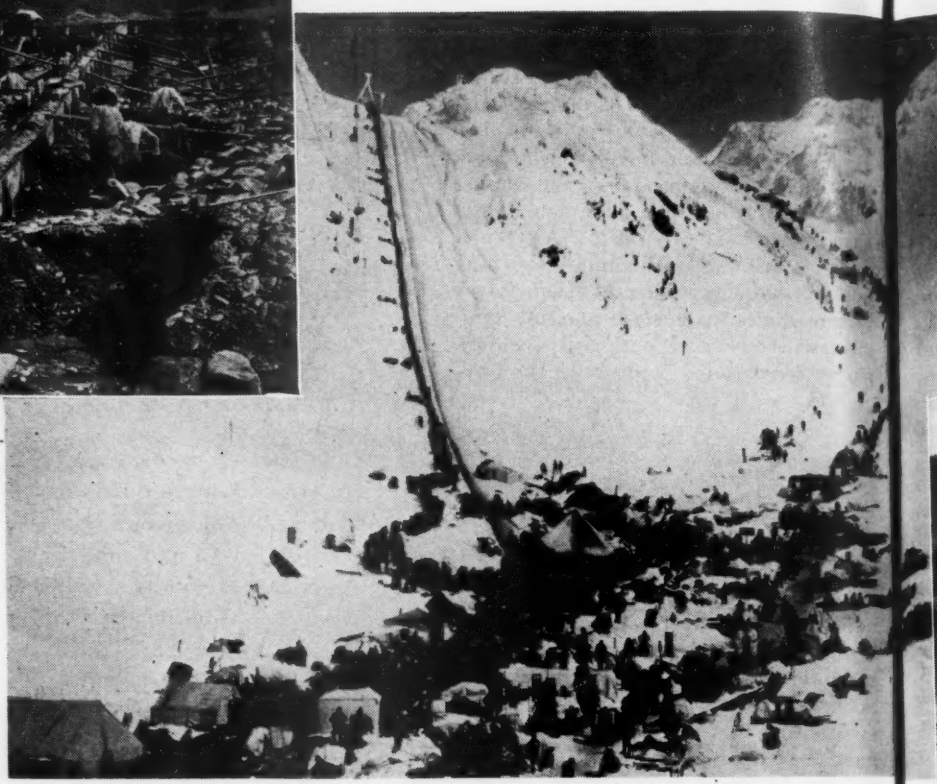
Gold Through the A

Lewis D. Anderson

EWING GALLOWAY PHOTO



EWING GALLOWAY PHOTO

KLONDIKE GOLD RUSH

The discovery of yellow flecks in the gravels of Bonanza Creek in 1896 precipitated one of the greatest of all gold rushes. Spurred by the urge for wealth, thousands of men braved the austere winter climate in a veritable stampede to locate and work placer claims. Within four years the population grew to 30,000, with more than 10,000 in Dawson City. In 1900 production reached a value of $22,000,000, then gradually dwindled. By 1910 the richest deposits were exhausted. The view above shows a camp at the foot of Chilkoot Pass, with streams of humanity crawling up to the summit by two different routes. The first diggings were hand operations such as that shown at the top-left. Most of them were supplanted long ago by mechanical dredges, one of which is illustrated at the right.

"WE MUST be paid more for our gold!" Statesmen, bankers, brokers, importers, and exporters, both at home and abroad, raise this age-old cry, which must have been heard in the market places of Babylon and in the slave markets of the Pharaohs. It was voiced in London around 1350 A.D., and has often been heard since then. In 1350 the British Mint paid a sum equal to $5.58 in United States money for a troy ounce of gold. In 1351 it offered $6.37 for the same amount. Today the U.S. Mint will give $35, and still there are people who want the price raised.

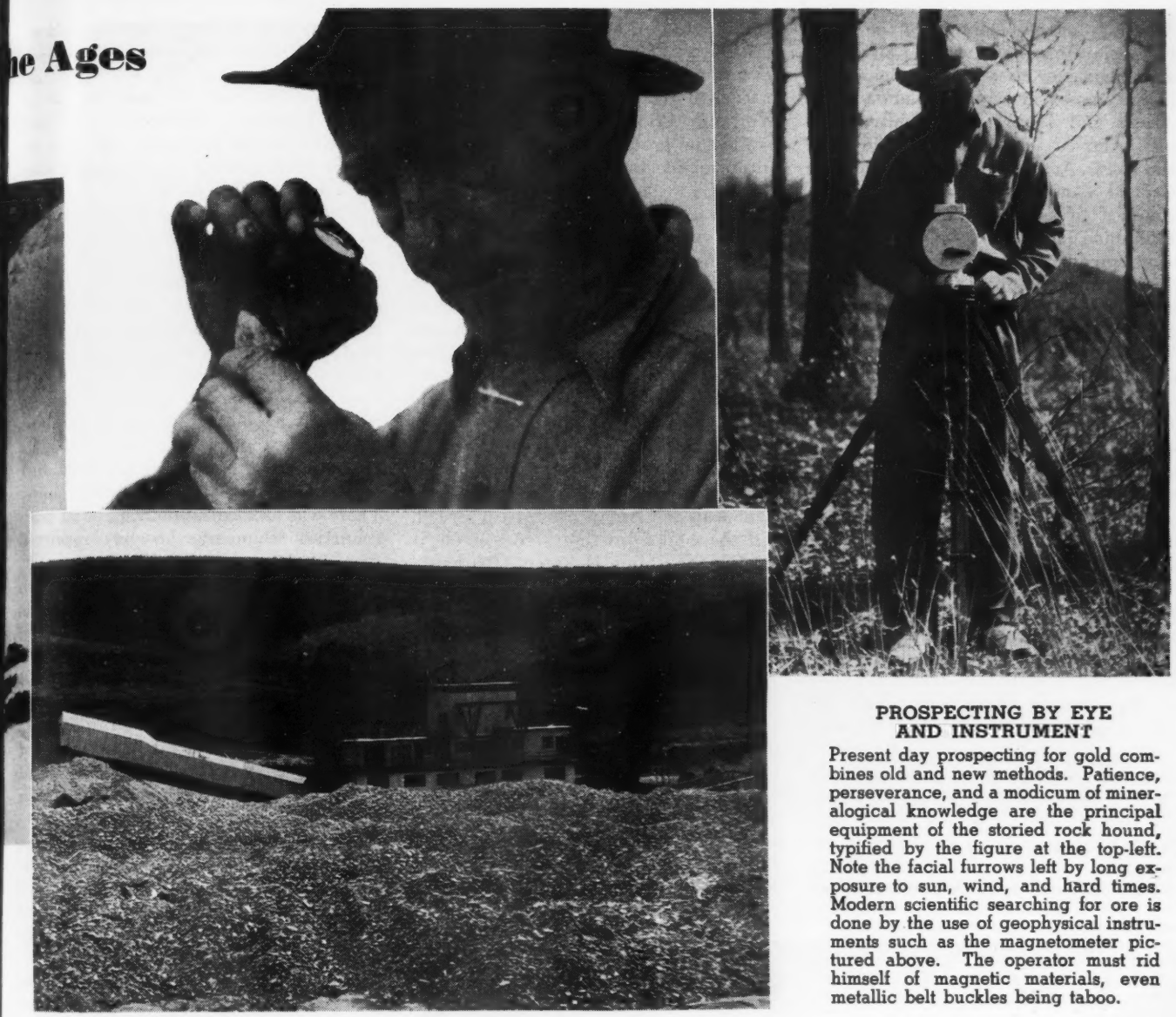
Gold has long been one of the world's most desired commodities. It is the only substance obtained from the earth that is freely accepted by all peoples. It is a metal with a characteristic yellow color that remains untarnished upon exposure to the atmosphere under well-nigh all conditions. Though it is found in nearly all parts of the globe, it is scarce nonetheless. This has made it precious and desirable in the human mind.

The search for gold began with the dawn of mankind, and the metal has been universally coveted ever since. No sooner is gold discovered somewhere, then life is transformed. It may be a savage, uninhabited place, but the strike changes it overnight. The deserts of our Southwest, of South Africa, and of western Australia were supplied with water in consequence. Men conquered the rigors of the Arctic, pestilential tropical swamps, and hostile natives. They first bring in only the necessities, then the conveniences, and, finally, the luxuries of existence. Another section of the world has come under the influence of civilization. But never has the longing for the possession of gold been satisfied.

Imagine some Folsom or Cro-Magnon hunter finding a nugget shining in a stream bed. Like a baby is attracted by some bright, shiny object, so that ancient Nimrod was drawn to the beautiful yellow pebble. He was able to pound a hole in it to hang it around his neck with his shells and other trinkets. "That's the prettiest thing I ever saw. I'll trade you my stone ax and staghorn spear for it," said his cave neighbor. Thus the first craving for gold was possibly expressed tens of thousands of years before the birth of Christ. In their explorations, archeologists have unearthed golden jewelry in many of the ancient cities such as Babylon, Ninevah, Assur, and places along the Nile.

When the Pharaohs were designing pyramids to hide their bones, they were also sending out excursions to dig for gold. Their desire for all the yellow metal they could get is indicated by the large number of guards and overseers in pictorial rock carvings extant in southern Egypt. Gold had passed the purely personal-ornament stage and had become more valuable as a medium of exchange, called money.

Authorities are generally agreed that the Lydians, about 700 B.C., invented gold coinage to dispense with the weighing of gold bullion in ordinary business transactions. But it was probably the Phoenicians who, centuries before, first used the metal as a medium of exchange. Who had a greater need for a medium of exchange than traders? Before it was available, the master of a vessel sailing into a foreign port with a perishable cargo had to sell it in the shortest possible time. After locating an interpreter, he proceeded to the market to barter it for other goods that he could exchange at the next stop. Also, he had to make enough on each transaction to enable him to feed his crew and to leave a profit for the owners. He could not carry a cargo that would spoil before he could get rid of it; that would be in demand in one port but not in another.



PROSPECTING BY EYE AND INSTRUMENT

Present day prospecting for gold combines old and new methods. Patience, perseverance, and a modicum of mineralogical knowledge are the principal equipment of the storied rock hound, typified by the figure at the top-left. Note the facial furrows left by long exposure to sun, wind, and hard times. Modern scientific searching for ore is done by the use of geophysical instruments such as the magnetometer pictured above. The operator must rid himself of magnetic materials, even metallic belt buckles being taboo.

EWING GALLOWAY PHOTO

Justifiably, traders needed a medium of exchange, and gold bullion came into use because it met all the requirements—it was durable, acceptable everywhere, valuable in small bulk, and retainable indefinitely.

All the peoples of the ancient world along the Tigris and the Mediterranean had gold. They worked many deposits, but traces of most of them have disappeared. Herodotus, the "Father of History," speaks of centers in Armenia, Chaldea, Asia Minor, and Egypt mined before the Christian era. Strabo and Pliny the elder wrote about those places and others in Italy, Greece, Spain, France, and India. According to Herodotus, gold from Macedonia gave Philip II of Macedonia and his son Alexander the Great the start that enabled them to conquer half the world. Strabo claimed that Alexander found gold and silver on his India campaign.

We have an epic in the Greek fable of the Argonauts. It was the first written narration describing a sea voyage whose sole purpose was piracy. Jason and the Argonauts sailed from the Aegean Sea to a point on the eastern shore of the Black Sea close to the gold camp of Colchis. At that placer camp west of the Caucasus Mountains it was mined by washing the sands through ditches lined with sheepskin with the fleece exposed to the water. The wool trapped the values and in time became yellow with accumulated gold. Jason wanted the precious metal, not the fleece.

Rome's wealth in gold increased more and more as she strove to become Mistress of the world. In the beginning she had little of it, for in 390 B.C., when the Gauls sacked the city, difficulty was experienced in producing a ransom of 1000 pounds in gold. Later, the metal was available in such abundance that it was used to make massive statues, to gild the ceilings of rooms, and Agrippina, the wife of Emperor Claudius (41 A.D.), wore a tunic made of gold. All that treasure, however, was soon scattered by the barbarian invasions.

The fact that the mineral is scarce has much to do with its desirability. Though it has been found in nearly every part of the world and kind of rock—even the waters of the oceans contain a little—it has usually occurred in such small quantities or low-grade ore bodies that it could not be profitably recovered. Most deposits that were worked before the introduction of the steam engine were the concentrated ones, and then only when natural conditions were favorable. Never has there been enough to cool man's desire to possess it.

In days long gone, the use of gold as ornaments was not confined to the Old World, but its use as money was. The Portuguese and Spaniards found the Negroes of the west coast of Africa so bedecked, and that was also true of the natives of India. When Columbus reached San Salvador in 1492 the aboriginals were wearing golden bracelets, earrings, and nose rings. For the Indians, gold had no value except for adornment, and so the Spaniards immediately started trading worthless beads and trinkets for the precious jewelry.

Those humble and peaceable trans-

actions were the beginning of the greatest explorations for gold and silver the world has ever known. The Spaniards, in their greed, overran the lands of the Aztecs and Incas. Eventually, their quest carried them from the middle of the North American Continent through Central America and most of South America to as remote a point as the Philippine Islands. News of the search soon spread, and in 1535 Charles V of Spain suspended operations in all Spanish mines and sent the workers to America to help amass the precious ores.

The practice of employing natives as slave labor was more or less universal in the sixteenth and seventeenth centuries. The explorers, stimulated by prospects of great gains and without regard for the aborigines' rights, forced them to toil by methods as primitive as those used in the reign of the Pharaohs, though explosives had been introduced in the mines of the Old World. A huge fire was built along the front or face of a small adit or cave. When the rock became hot, the Indians, clad only in light garments, rushed in and threw cold water on the stone, the sudden cooling causing it to chip and spall. All the loosened pieces that didn't fall were mauled off before another fire was started. The Indians gathered the hot fragments in deer horns and emptied them in reed baskets. These were carried to *arrastras* or grinding mills where the rock was pulverized and the gold recovered.

The Spaniards and other early miners were limited in their operations for lack of facilities. The mineral had to occur in its native state as free gold, and the deposits had to be rich or well concentrated. Workings seldom reached more than 100 feet below ground. All openings were on an incline so that the natives could carry the loads to the surface either on their heads or backs.

The exploitation of mines with slave labor and the looting of palaces and temples in Mexico, Central, and South America furnished Spain with gold in such quantities as to cause momentous disturbances in the economical structure of Europe. It enabled Charles V to restore greatness, if but for a brief time, to the Holy Roman Empire. It helped to buy off the Turks under Suleiman the Magnificent and to keep them out of western Europe. The Spaniards controlled all the Americas west of Brazil, and the gold from those lands made it possible for Phillip II, son of Charles V, to drive the last of the Moors from Spain. It built the Spanish Armada that was destroyed by the English under Queen Elizabeth.

The Spanish conquistadores missed many of the New World's treasures because they sought for them with the gun and sword instead of the pick and shovel. They dreamed of the glittering domes of the fabulous Seven Cities of Cibola, of Indian temples where they would tear solid-gold images from their pedestals. Visions of gold and silver were cherished by the French while they controlled a large section of North America. However, the latter were really more interested in the fur trade and did little prospecting. They did mine some lead in the upper Mississippi Valley, but did not locate any of the large gold and other ore bodies developed by the Americans after the Louisiana Purchase.

The English Crown kept a sharp eye on minerals while she was granting charters for her American Colonies. Like Spain, England specified that one-fifth of all precious metals and one-fifteenth of copper discovered in the territories covered by the grants must accrue to the Crown. "All that glitters is not gold." Captain John Smith found this to be true early in colonial history. Like most leaders, he took mining seriously. He sent a shipload of glittering, yellow dust to England from the Virginia Colony. There was great disappointment in both countries when the jewelers reported that the cargo was worthless mica.

Little mining was done in the English Colonies. The Indians' only metal was native copper that they picked from stream beds and gravel banks where it had been deposited by glaciers that had carried the pieces from the region of the Great Lakes. Benjamin Franklin, as late as 1790, when arguing in favor of paper currency, remarked: "Gold and Silver are not the products of North America, which has no mines."

Until 1848 that learned gentleman's opinion seemed to be correct. The Appalachian belt from Newfoundland southeast to Alabama had scattered gold veins. Several small properties were worked in Virginia, the Carolinas, Georgia, and Alabama. United States mints were established at Charlotte, N.C., and New Orleans, La., to facilitate handling the gold. Output was relatively unimportant as compared with California, which mined far more in 1849 than that whole district produced from 1607 to 1848. But it did render a vital service in the apprentice training of miners for California and other western camps.

Prior to 1848, the Spanish rulers of California knew of the existence of small gold deposits but gave them little thought. Those dons were a different class of Spaniards than the conquistadores. Possibly, because they were longer removed from the Old World, the Mexican Spaniards were disinclined to encourage mining in California. The large landowners feared that such ventures would strip the laborers from their fields—the Church was afraid she would lose her dominance over the Indians. Events proved their forebodings to be correct.

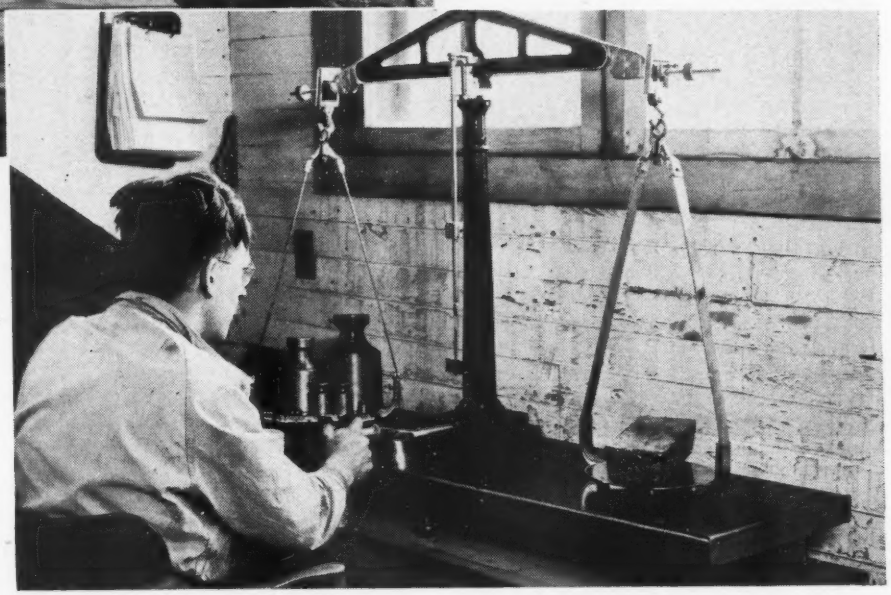
Mexico ceded California to the United States on February 2, 1848, at the end of the Mexican War for $15,000,000. On January 23, just nine days earlier, gold had been found at Sutter's mill near the present city of Sacramento. In 1849,

BETTMANN ARCHIVE PRINT

BLASTING BY THE INCH

Before explosives were available, rock faces were first heated by building fires in front of them and then cracked surficially by dashing cold water against them. Most of the world's early tunnels and mine openings were advanced by this tedious process. In limestone formations the Romans used vinegar instead of water to take advantage of the chemical reaction of the acetic acid. The illustration is from an 1867 woodcut.

EWING GALLOWAY PHOTO



A GOLD BRICK AND ITS PROBABLE DESTINATION
Below, a bar of gold bullion is being weighed in a Canadian mine. It represents the fruit of much human toil and the chances are good that it will end up in Fort Knox, Kentucky, Uncle Sam's fabulous golden storehouse (left). Although universally acceptable as a medium of exchange, coinage of the precious metal ceased in 1933 and gold dollars are now little more than a figure of speech.

one year later, California produced gold worth three times the purchase price. News of the discovery spread the world over and aroused man's greed for gold. From the eastern part of the United States and Europe there ensued an excited migration across the western plains, over the Isthmus of Panama, and around Cape Horn. Ships of all flags were stranded in California waters as their crews deserted for the gold fields—the Eldorado that called the young and the adventurous.

Several advances in mining methods were introduced during that sensational period. From the gold pan, the next step was the rocker, which was followed by the long tom and the practical sluice box. Along with those developments came hydraulic mining—the use of water under high pressure to wash the sand through the sluice boxes. The dredge, too, was first utilized for digging gold in those days.

Two years after the yellow metal was discovered there, California was admitted into the Union as the thirty-first state. Entering as a free state, the output of gold had a tremendous influence on the slavery question. It furnished the capital for the great civil split and helped the North to finance the war. A total of $186,000,000 worth was produced during 1861-64. What would the history of the States have been had that sum gone to the South instead of the North?

The tempo of the settling of the West was greatly increased through the gold rush. At the time of her admittance to the Union, California was 2000 miles distant from the nearest state. In their search for the earth's treasures, her adopted sons spread out over the last American frontiers and played an important part in establishing the remainder of the western states. They went across the Sierra Nevada Mountains into the western part of the Territory of Utah, now the State of Nevada. There the great Comstock silver and gold lode was discovered in 1860, and almost overnight the population of Virginia City grew from a few miners to a community numbering 30,000. Nevada entered the Union in 1864.

Russell Green and his party of miners from Georgia, returning east from the California fields, struck gold on Cherry Creek near the present City of Denver. That resulted in the "Pike's Peak" rush and the settlement of Colorado. Californians were prominent in the Coeur D'Alene gold district in eastern Washington and Idaho during 1855-56. Many of the Eldorado miners went into the Black Hills and the Homestake district in 1877. Cripple Creek, Colo., drew them in 1891, and other camps offered golden fleece.

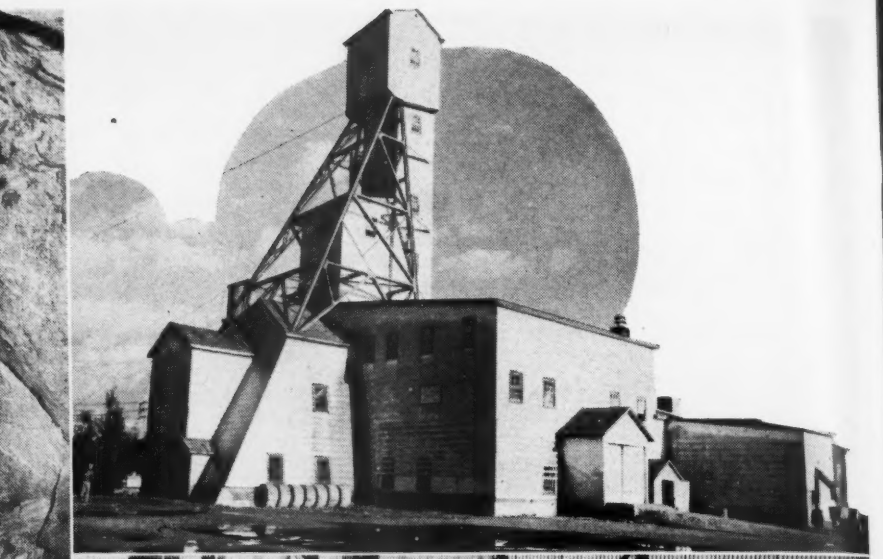
Among the seekers who joined the migration to California was a certain Australian. After spending some time in the various diggings, he noticed a similarity in the rock and gravel formations in California and those in his native land, New South Wales. He returned home as soon as he had his passage money, and in 1851 found gold on the Macquarie River and started the great rush to Australia.

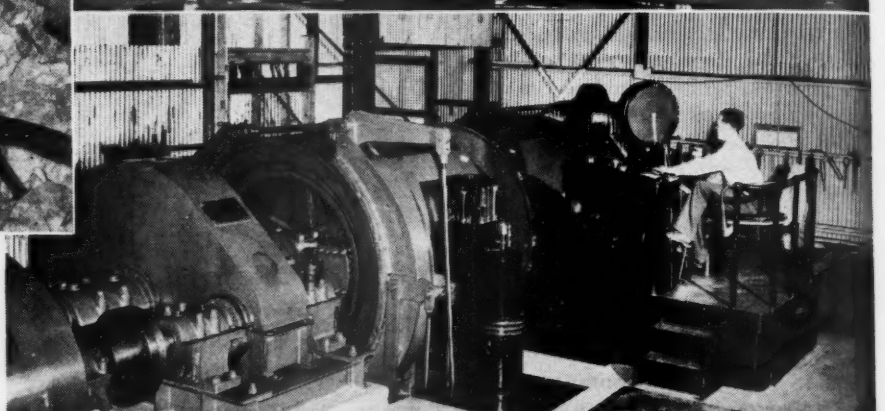
Gold! Gold! Gold! With the Klondike discovery in 1898 the magic word again precipitated a stampede of the adventurous, and more names were made famous. Dawson City, Skagway, Chilkoot Pass, White Horse! Here was mining at its roughest. Gravel banks were frozen perennially, and had to be thawed in order to be moved. But the golden sands just above bedrock more than paid for the disadvantages and hardships.

Klondike was in Canada, but that rush opened up the interior of Alaska and resulted in the development of several large gold mines, among them the Treadwell, the Juneau, and the Gastineau. Alaska, like California, has turned out to be a profitable investment. It was purchased by the United States from Russia in 1867 for $7,200,000 and since then has produced better than $500,000,000 in gold alone. Would world history have been different if that wealth had gone to Russia?

In recent years, most of the earth's gold has been obtained as a by-product of the metallurgical treatment of other metals such as copper, lead, and zinc. Much of the romance of the early mining camps is gone; there have been few gold rushes since the turn of the century. The latest one was in 1946 at Yellowknife, Northwest Territory, Canada, on Great Slave Lake.

The use of steam plants and, later, electric power, together with heavy machinery, have lowered the depth of the mining horizon thousands of feet since the days of the California stampede, while flotation and cyanidation have made feasible the working of many low-grade properties. An estimated 28 million ounces was produced in 1947, with no report from Russia. Of that total,





TYPICAL SMALL GOLD MINES

Gold mining is profitable today only where the ore is rich or mining conditions are unusually favorable. Gold mines in the United States were closed by government edict during the war, and few exclusively gold properties have been able to resume operations since then. Canadian mines kept going despite a fixed price of $35 an ounce for the metal and continually rising production costs. For the past several years a government subsidy has helped marginal mines to survive, and the recent 10-percent devaluation of the Canadian dollar has boosted the price of gold to $38.50 an ounce. During September, the latest month for which official figures are available, the Dominion's gold output was the highest in seven years. For the first nine months of 1949 it was 17 percent greater than in the corresponding period of 1948. Production is currently running at around the annual rate of four million ounces, worth $154,000,000. These pictures were taken at typical small workings in the Crow River area of northwestern Ontario. At the top is the shaft headframe of the Central Patricia Gold Mines. The Canadian Ingersoll-Rand hoist shown just above moves ore and men at the Pickle Crow property. Driven by a 500-hp. motor, it can lift a load of 21,000 pounds at a speed of 1400 feet per minute. A Pickle Crow miner is seen at the upper-left drilling in a pillar with a DA-35 drifter mounted to serve as a "sinker."

South Africa contributed 40 percent and the United States approximately 5 percent.

From ancient until modern times, gold has been sought by man. The more civilized he became, the more might he exerted if opposed in his quest by alien peoples. To witness: The East India Companies—English, Danish, Dutch, French, Portuguese, and Swedish—looted India and the East Indies, carrying off gold and gems under the protection of their navies and armies. The Transvaal or South African War was started because the Boers refused the English the right to mine in their country. The latter won the fight, and now control the Witwatersrand, one of the world's greatest gold producers. The Indians persistently opposed mining and settlement of our Southwest by Spaniards, Mexicans, and, later, Americans. Power eventually forced them onto reservations and opened the territory for exploration. In the last war, one of the first items pilfered from each newly conquered country was gold.

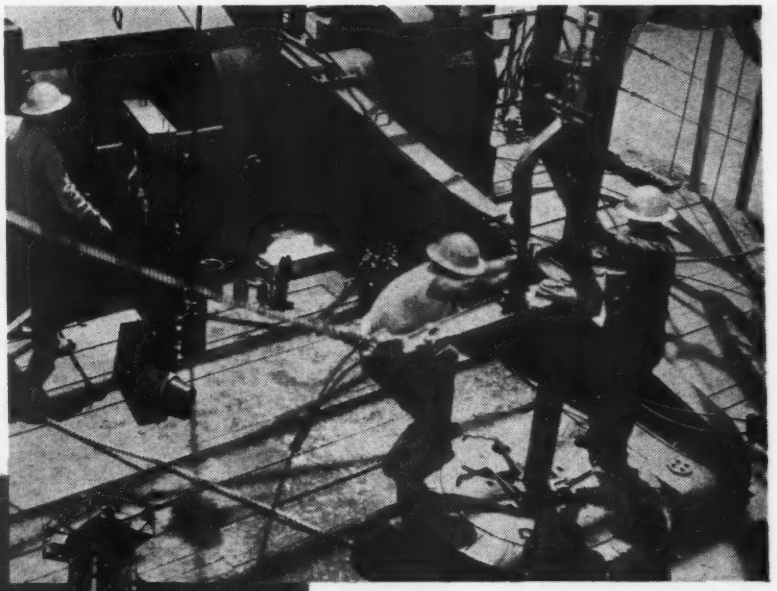
With all the world's ills, man still dreams of gold and riches. Many Virginians and Carolinians keep a constant lookout for a legendary massive boulder of gold in the Blue Ridge Mountains. As the story goes, a Confederate deserter, after sleeping on the rock one night, carved off a large piece of moss to help keep his water bottle cool. Later, it was found that the growth had come from a solid-gold boulder. So far as is known, no one has ever relocated the place.

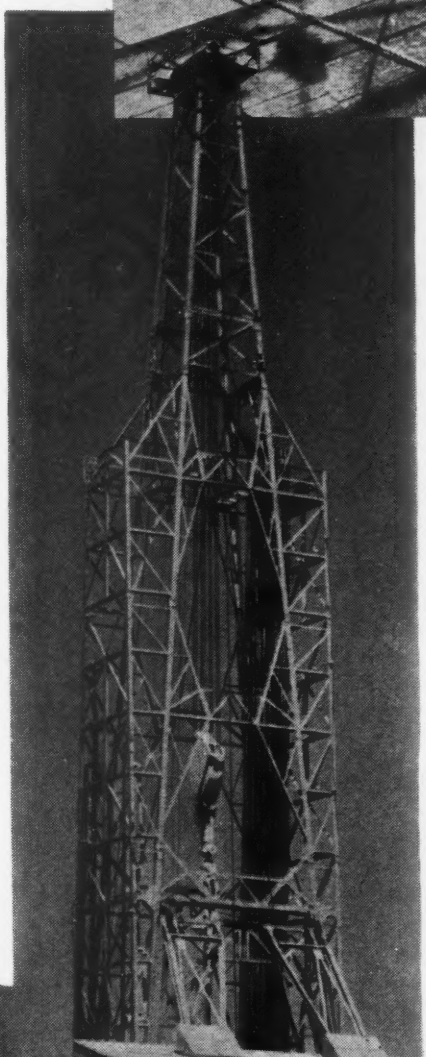
Numerous similar tales are told about our West. Pegleg Smith is supposed to have discovered a mountaintop covered with gold. He was never able to find the deposit again, and the range is now called Smith Mountains in doubtful honor to him. On a trip through southern Nevada Jacob Breyfogle and companions came upon an outcrop that yielded gold specimens. All but Breyfogle were killed by Indians, and he was severely beaten. After wandering for several days through the desert heat with no water, he was rescued. His mind was a blank, and the source of the precious metal has always eluded seekers. The Lost Dutchman! Gold in the Superstition Mountains! And, more recently, Death Valley Scotty's mine in the Funeral Range.

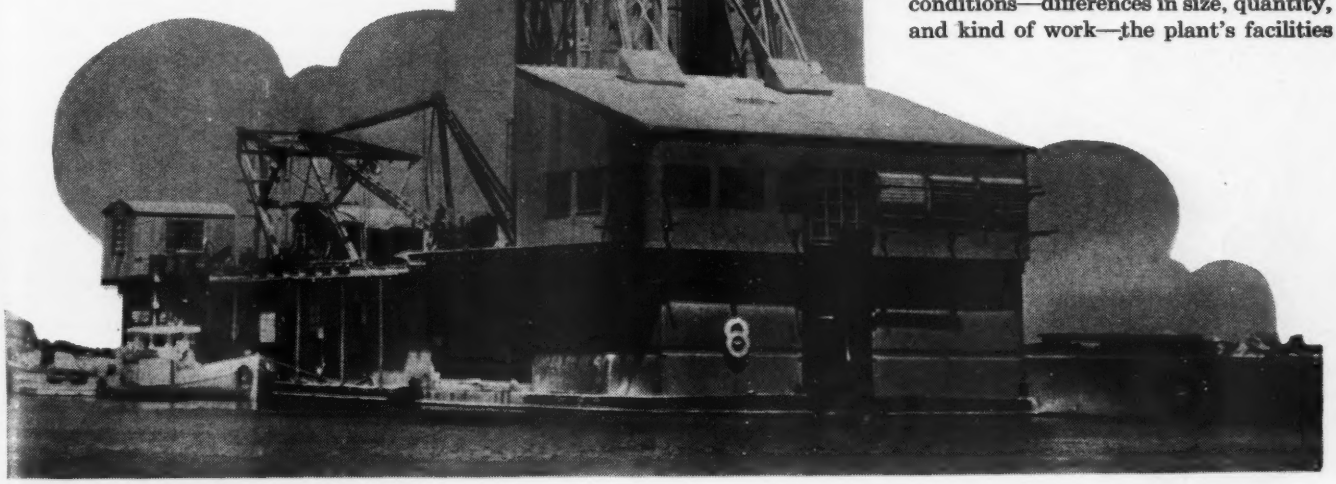
The theme of all these stories is the same—a gold discovery lost through death, Indian torture, mental derangement on the part of the original prospector. People still search for these fabled riches as they do for buried pirate treasure. And if they were ever to find them they, too, would cry, "We want more dollars in exchange for our gold."

Air Power Helps to Build Oil-Well Rigs

Emsco Derrick & Equipment Company Takes Many Factory Short Cuts with Ingenious Pneumatic Devices







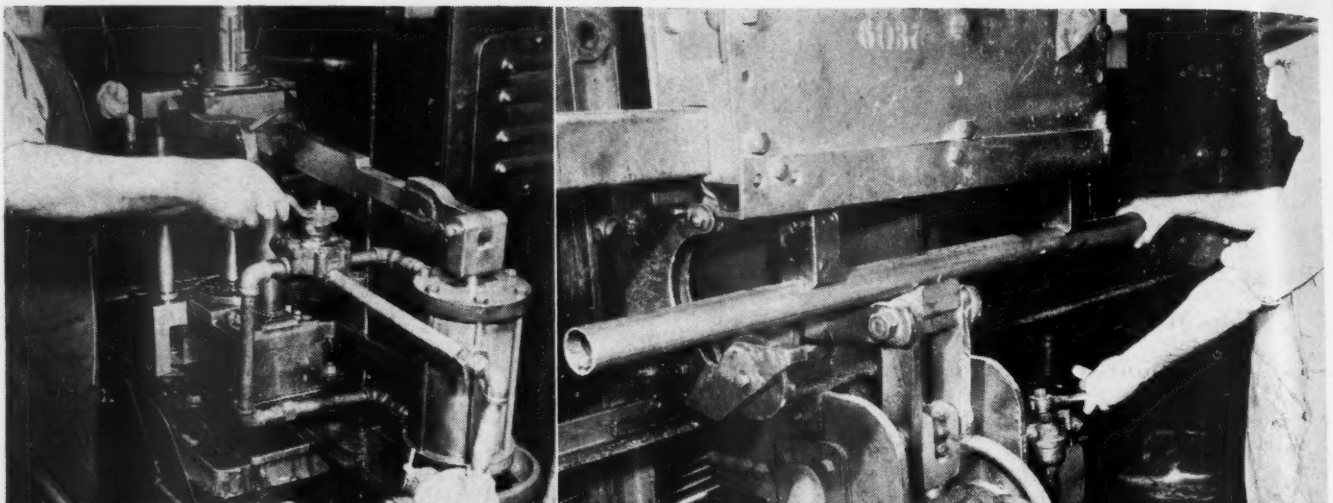
EMSCO DRILLING EQUIPMENT
The barge-mounted drilling rig, left, for use in the bayou and marsh sections of the Gulf Coast has a double-bulge mast that provides room at the sides for racking drill pipe. The mast serves the same purpose as a standard derrick and may be quickly detached and moved to another location. One steam-operated Emsco rig now in service is so large that driller, derrick man, and fireman maintain contact by an intercommunication system. Much of the hard work on modern rigs is done by air-powered devices. The view of the drilling platform of a rotary rig, above, shows tongs being used to make up pipe joints.

AN ARTICLE in our March, 1949, issue, entitled *Compressed Air —New Oil-Field Roughneck*, describes a recent trend towards the use of this form of power on oil-well drilling rigs and other equipment. Information received since then discloses that while the application of compressed air in this field may be news, its use by at least one manufacturer of such equipment is an old story.

Emsco Derrick & Equipment Company is the firm in mind. Founded under the name of Emsco Steel Products Company in March, 1923, near Los Angeles, Calif., it was among the first industrial plants to locate in that area and devoted its efforts to turning out a limited line of oil-well drilling equipment. The concern was a pioneer in the building of steel derricks and designed the first ones used in the California fields.

Continued growth and expansion enabled the company to add to its stock more and more of the oil-well driller's tools of the trade, and today it produces a complete line including drilling rigs, rotary machines, hoisting blocks, swivels, slush pumps, portable masts, steel derricks, plunger pumps, sucker rods, and miscellaneous accessories. It also makes radio and power transmission towers, substructures, dead-line anchors, barge walkways, casing racks, and other structural items. In addition to the main establishment in Los Angeles, Emsco has branches in Garland and Houston, Tex. The latter and the Los Angeles plant do commercial hot-dip galvanizing.

At the main plant activities are divided into two classes. One involves the contract work of various types and sizes that continually moves through the shops; the other is more of a production-line nature in that the operations are consistently the same. The products turned out range from small accessories, which can be held in the hand, to giant drilling rigs. Because of these changing conditions—differences in size, quantity, and kind of work—the plant's facilities



COMPRESSED AIR & GAS INSTITUTE PHOTOS

AIR-OPERATED FACTORY AIDS

In the Emsco Los Angeles factory, now engulfed by the city but located in a cattle-grazing area when it was established in 1923, air-powered equipment handles many jobs. Most of the machines and fixtures were designed and built by Emsco production men to lighten labor and to increase output. Shown at the left is an automatic honing machine. The air cylinder actuates an attached arm that clamps pieces securely in place while they are undergoing work. The air-operated machine at the right straightens bent liner-shell stock.

have to be elastic and frequently improvised. This partially explains the extensive use of compressed air which, by reason of its adaptability, together with the simplicity of air-operated devices, is an ideal power medium.

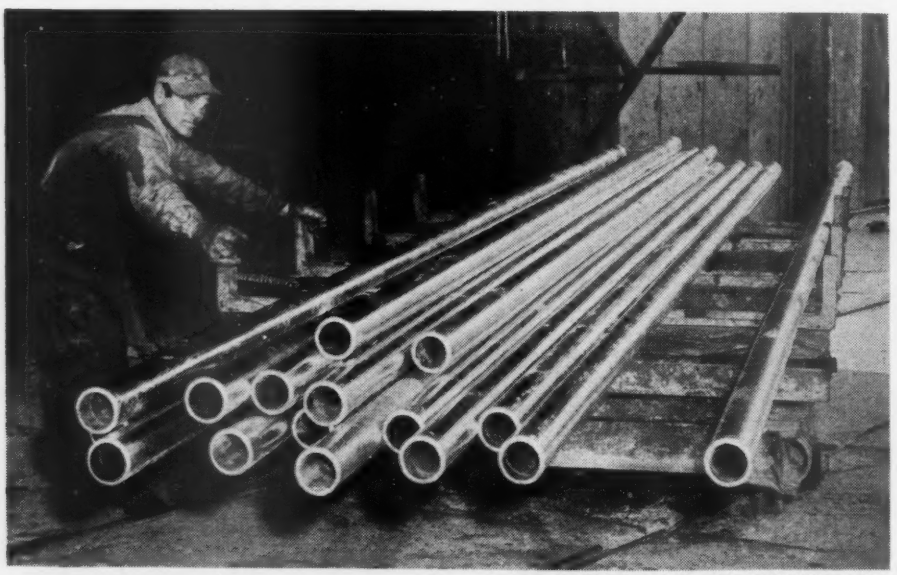
Many of the machines and tools in the Los Angeles plant were made there to meet requirements, and are quite ingenious. For instance, the machine shop has a straightener that takes kinks out of steel liner shells. The fabricated shell is placed in the unit and rotated while the operator chalks the high spots. Then he applies the relentless but elastic pressure of an air piston against those areas to force them back into line. By merely turning a screw, he can vary the stroke of the piston and also the pressure. This machine, devised by Emsco engineers, does in a few minutes what it would take hours to do by machining, and also eliminates the necessity of using the much thicker-gauge pipe which would be required in the case of machining.

Honing also is facilitated by compressed air. The straightened liner shell next goes to a centerless grinder, where an air cylinder clamps one end against a soft-steel plate. This hold-down fixture assures a precision fit and not only prevents the liner from turning during honing but likewise reduces loading and unloading time. This improvement over manual tightening was made in the company's own plant, equipment for the purpose being unavailable. Since then several types of honing machines, carrying air-operated hold-down clamps as standard equipment, have appeared on the market.

In the structural shop are pneumatic squeeze riveters that perform several operations. In one instance they apply pressure to dies to form hook bolts and J-bolts; in another, heated and upset ladder rungs are crimped and at the same time annealed under the pressure of two air cylinders attached to a ladder-assembly jig.

A big punch press used to make complex derrick parts has an air-actuated automatic locater provided with air cylinders that serve as stops for the work. First, pegs are set on the base plate of the press in accordance with the pattern to be reproduced, and then the material is clamped in place by a pneumatic vise. After the punching operation, the cylinder pistons retract, permitting an air motor to advance the work past the pegs for the next punch.

In a corner of the shop where contract work on water tanks is done, air cylinders operate an arm that lifts rolled metal sections from the floor and drops each into the positioner of an automatic welder. As it does so, a length of fire hose, which is a part of the positioner, is inflated with air to grip the work firmly. After weld-



COMPRESSED AIR & GAS INSTITUTE PHOTO

SWITCHING YARD-TRANSFER CARS

One man and an air-powered turntable make short work of switching a load of pipe from one track to another. This system, which is used at all car-transfer points in the plant, speeds up delivery of materials from warehouse or stockpile to the operating floor.

ing, an arm of the same type sets the assemblies back onto the production line. No manpower is wasted on this lifting job.

A typical example of the application of compressed air in materials handling can be found in the galvanizing department, which does considerable contract work in addition to its own. There, the parts to be galvanized are raised and lowered into pickling vats by 2-ton air hoists, while overhead trolleys driven by air motors move the loads to and from the vats. Compressed air also serves to transfer sulphuric acid from railway tank cars to storage tanks located 200 yards from the siding. This is done by attaching an air line to the top of each car and admitting air at 30 psi. pressure to push the acid out and into the storage tanks through a 2-inch acid-resistant hose.

The movement of yard transfer cars that run on rails and carry materials to different parts of the plant is speeded up by air-operated turntables located at all switching points. An air cylinder actuated by a control valve lifts and lowers each table, while a ball-bearing race on which it rides enables one man to swing it and a 5-ton car with ease to an intersecting track.

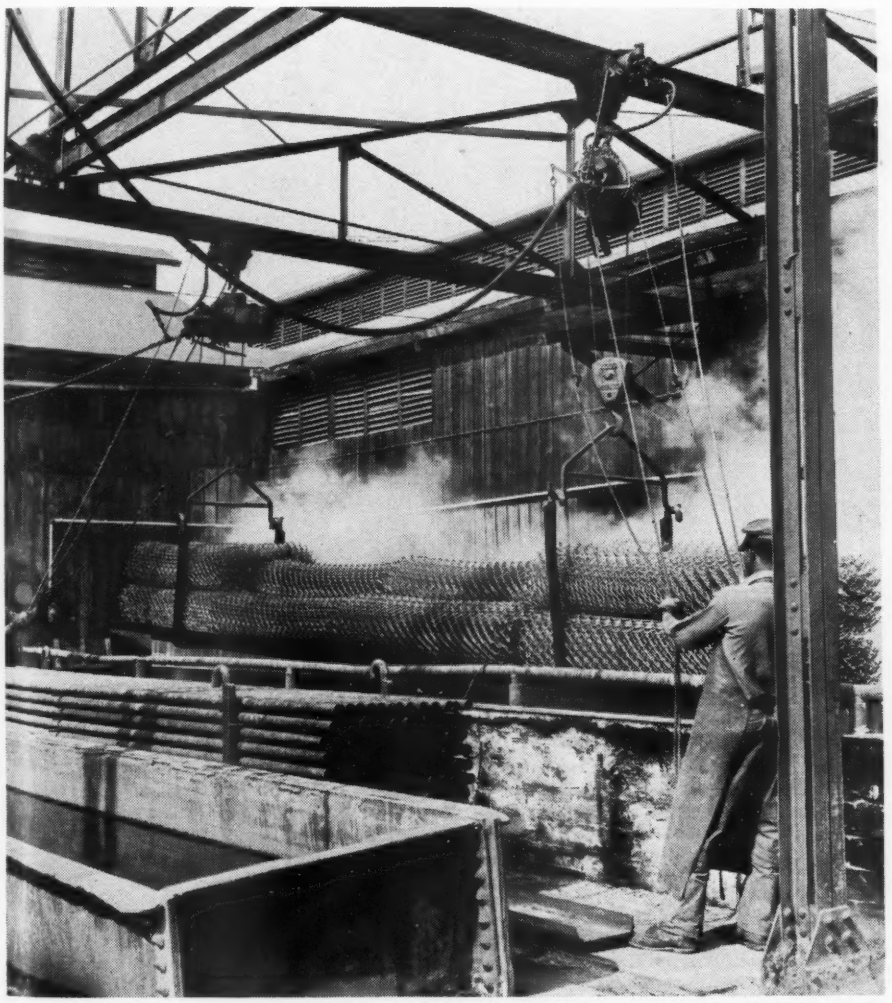
Portable pneumatic tools are a common sight in the plant. Paving breakers, chipping hammers, grinders, drills, etc., are used on many construction, installation, and maintenance jobs because they are light in weight in relation to the power they develop, have variable speeds, are not damaged by stalling or overloading, and require little maintenance. Air outlets are provided at frequent intervals throughout the buildings and yard to power them, as well as the special pneumatic devices that are often rigged up to do unusual work. Outside of occasional checkups for leaks, the air lines offer no problem as regards economy of operation and safety, for they need no insulation against heat loss or freezing and their use involves no risk of fire or shock.

Anyone observing compressed air at work in so many ways and parts of the oil-well-equipment establishment would readily agree with the remark made by one of the engineers that "Compressed air is the lifeblood of the plant." The heart of the air system is a centrally located compressor house equipped with two large stationary 2-stage machines with respective capacities of 1100 and 500 cfm. Each has a separate receiver, both of which are connected so that the air lines can be supplied even though one unit may be out of order. A standby compressor of 750-cfm. capacity, installed on the opposite side of the yard for emergency service, is also tied into the system.

Compressed air is used to a considerable extent in connection with some of the products Emsco manufactures. All friction clutches on their drilling rigs are pneumatically operated. On several models, air under pressure shifts the jaw clutches and starts the engines. It also serves to operate catheads (capstans) and brakes on sand-line reels (general utility lines on rotary rigs). Much experimental work has been done towards equipping drawworks with pneumatic brakes.

The trend towards the use of compressed air on drilling rigs is attributable to two factors. In the first place, the ever-increasing depth to which holes must be drilled to reach producing wells calls for larger rigs and heavier equipment that impose great strain on drilling crews. (Holes have approached and, in one recent case, exceeded 20,000 feet in depth.) Much of that back-breaking labor has been taken over by compressed air. The second factor is of an economic nature. By lightening the load on the crews, compressed air saves time on work where minutes mean dollars.

One of Emsco's drilling rigs—Model GA-350—is an excellent example of the extent to which compressed air, through controls centered at the driller's station, helps to operate equipment of this kind. Variable-pressure valves on the 350-hp. unit control the direct air-actuated friction clutches of the master, rotary, and drum high drives. Push-button on-off valves control Fawick Airflex engine clutches, as well as the pneumatic friction disk clutch of the slush pump. Additional push buttons operate splined multiple-jaw clutches in the built-in selective-speed transmission of the drawworks, and an air-controlled mechanical locking system prevents the operation of any one of them until all the others are disengaged. It also prevents the jaw clutches from functioning while shafts are rotating. This air-control system makes it possible to change the hoisting and rotary speeds instantaneously to other preselected speeds. "Fighting" of mechanical controls and clashing of jaw clutches are eliminated and faster and more efficient operation is achieved.



COMPRESSED AIR & GAS INSTITUTE PHOTO

HOISTING WITH AIR

Two Ingersoll-Rand Size D industrial air hoists, suspended from trolleys driven by air motors and running on the lower flanges of I-beams, handle rolls of woven-wire fencing during the pickling process that precedes galvanizing. Having a lifting capacity of 2 tons each, the hoists shift heavy loads quickly, are easily controlled by hand lines, are unaffected by weather or by fumes from the pickling vats, and are safer than electric hoists for work in such damp surroundings.

Half an Acre of Planned Confusion

Pittsburgh Contractor Crowds Small Plot with Equipment to Excavate for Foundation of Skyscraper

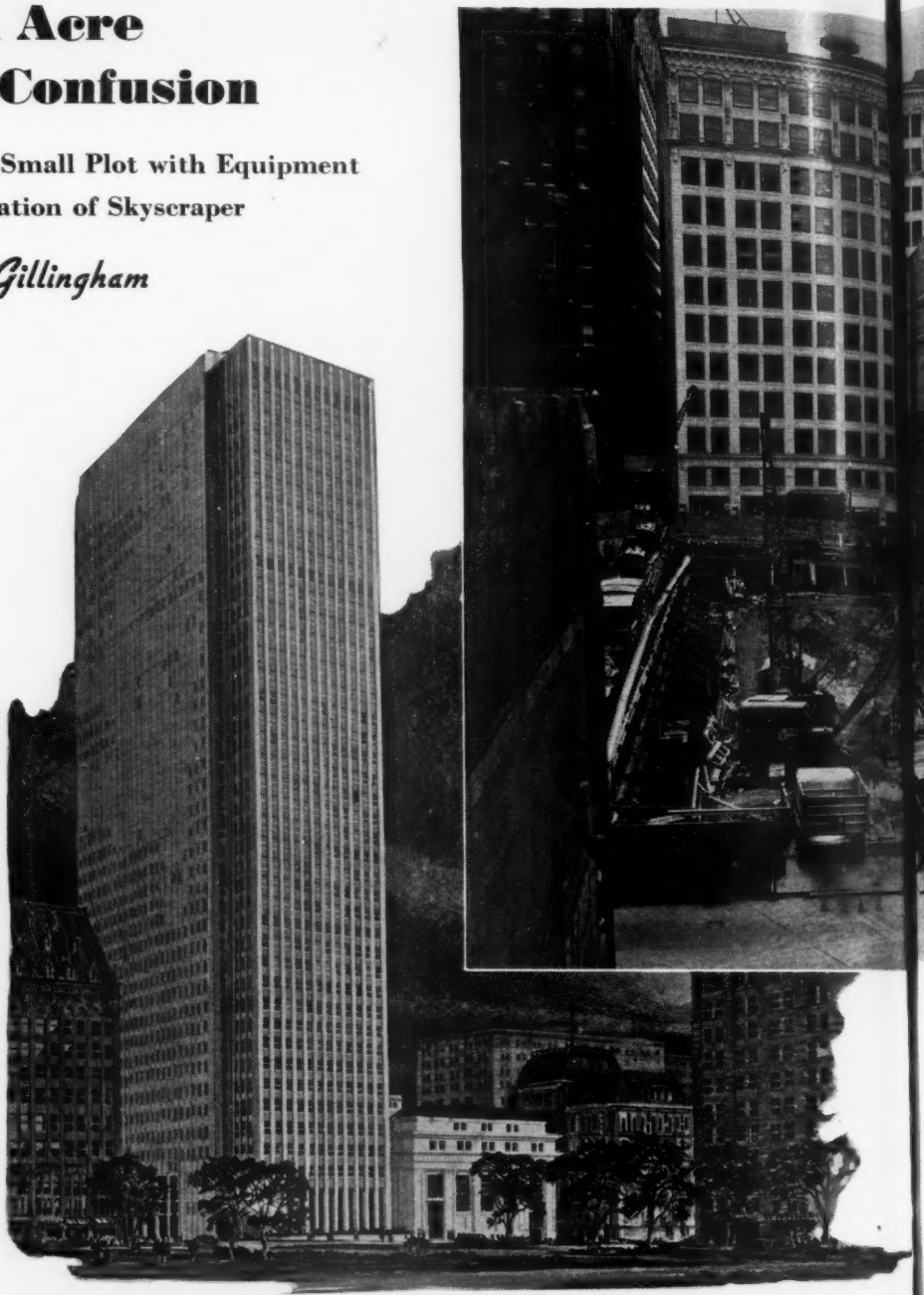
Walter P. Gillingham

ONE contracting firm that doesn't mind a tough assignment is The John F. Casey Company of Pittsburgh, Pa. When the firm undertook to construct a foundation for the 39-story U. S. Steel-Mellon Bank Building scheduled to rise in Pittsburgh, it knew skillful planning would be needed to fit enough men and machines necessary for the job into the small space available.

Not only cramped quarters but also the location of the structure handicapped normal operations. The site, in one of the busiest downtown sections, is sandwiched between the present Mellon Bank and the Union Trust Building and is across the street from a large department store. Adjacent to it is the William Penn Hotel with its constant stream of incoming and outgoing autos and taxis. Bigelow Boulevard, one of the city's main thoroughfares, dumps its load of moving vehicles a few blocks away. Add to this congestion the pedestrian traffic normal to the business section of a place the size of Pittsburgh and you have a problem in carrying on construction without causing serious traffic tie-ups.

When Casey's moved on the job last August it requested and got permission to use the sidewalks bounding the lot on three sides, as well as half the street on the east side. These and the 114x228-foot building site made up all the operating room at its disposal. To save space, the company erected its general and engineering offices on supports. The area underneath served to park automobiles, to store tools, supplies, etc., and as a passageway for the movement of materials.

In the remaining space was massed the following major pieces of equipment: five cranes (at one time there were six on the job), two pile drivers, seven portable compressors, three wagon drills, 23 jackhammers, 28 paving breakers, seventeen clay spades, three welding machines, four power saws, two woodboring machines, and a portable forge shop. Nine clamshell buckets, seven sump pumps, five concrete vibrators, six tampers, and a number of chipping hammers and other portable tools rounded out the list. Fuel drums, tool chests, and sheds also took up room, and a steady stream of supply, dump, and concrete-mixing trucks added to the congestion.



COURTESY OF HARRISON, ABRAMOVITZ & COCKEN, ARCHITECTS

NEW BUILDING AND LOCATION

An artist's sketch, left, depicts the $27,000,000 U.S. Steel-Mellon Bank Building that will rise on the foundation The John F. Casey Company is constructing in downtown Pittsburgh. The structure will have 39 stories, a penthouse, and three basement floors. The low, white structure right of it is the Mellon National Bank Building, erected in 1923. The vertical strips on the front of the new edifice will be of stone—granite will be used for the first four stories and limestone for the higher ones. All spaces between them, except windows, are to be sheathed with gleaming stainless steel. Floors throughout will be of the Robinson type, steel covered with lightweight concrete and containing all necessary electrical conduits and outlets. The fifteenth and thirty-second floors are to be "mechanical." Housing pumps, blowers, tanks, and other air-conditioning equipment, they will divide the building into three air-conditioned zones. The park in the foreground, although not a part of the project, is to be known as Mellon Park. Mellon interests gave the city four million dollars with which to purchase the tract and to construct a garage with five levels underneath it. The surface area will be both park and shopping center, with trees, shrubs, walkways, memorial fountain, flag stand, restaurants, stores, etc. The picture at the right shows the building site, flanked on the right by the Mellon National Bank. When the structure is completed, the bank will enlarge its facilities by taking over the first four floors. Those above will be occupied by the U. S. Steel Corporation.

In order to maintain all these machines and a full-sized construction crew on approximately half an acre of ground, to keep them supplied with materials and yet not interfere with traffic, the firm was forced to call on all its skill and experience. At times it has juggled men and materials in a way rem-

iniscent of a heavily laden waiter cutting across a dance floor during a jitterbug contest.

General foundation plans called for a continuous outer wall 114x228 feet in size. Its thickness was to vary from 2½ feet on the north and south sides to 6 feet on the east and 7 feet on the west next to the Mellon Bank Building. Spaced throughout the area within this enclosure were to be erected 25 concrete piers ranging in dimensions from 9x12 to 14x15 feet. Both the piers and the wall were to be carried down to rock firm enough to bear the weight of the 39-story structure.

Excavating for the outer wall is being done by the open-cofferdam method. Standard 6x16-inch interlocking steel piling was driven along each side in two rows about 12 feet apart. As earth was removed, it was forced progressively deeper, and the two lines were braced with 12-inch H-beams and 8-inch struts cut and welded on the job. More than 860 tons of piling was used in constructing the walls. The inside row is to be pulled out before the space is filled with concrete, but the outer one will be left in place.

Rock underlying the location is typical horizontally bedded Western Pennsylvania shale. Excavating crews in the open cofferdam struck first one and then a second layer of red shale. Seeking a firmer material, they continued until they reached a thick bed of solid blue shale, which was deemed suitable as a support for the building. But engineers on the job were not satisfied with that; they went from 9 to 10 feet deeper at all points than planned in order to insure completely satisfactory footings for the foundation.

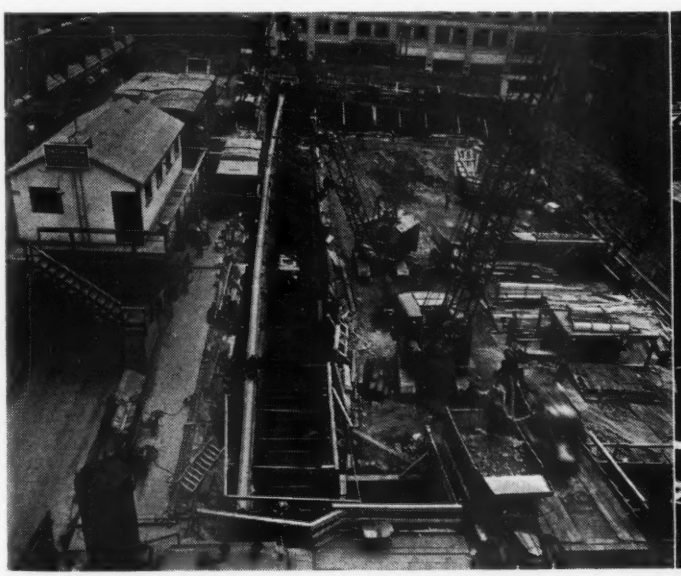
Drilling in rock is being done with Ingersoll-Rand J-50 Jackhamers provided with types 1 and 2 four-point, side-hole Jackbits. PB-8 paving breakers fitted with moil points are used where the going is easier. Two FM-2 wagon drills are also at work in the open cofferdam putting down line holes for blasting. Muck is removed by the five cranes on the job, the clamshell buckets ranging in size from ¾ to 1½ cubic yards and loading into 8-cubic-yard dump trucks.

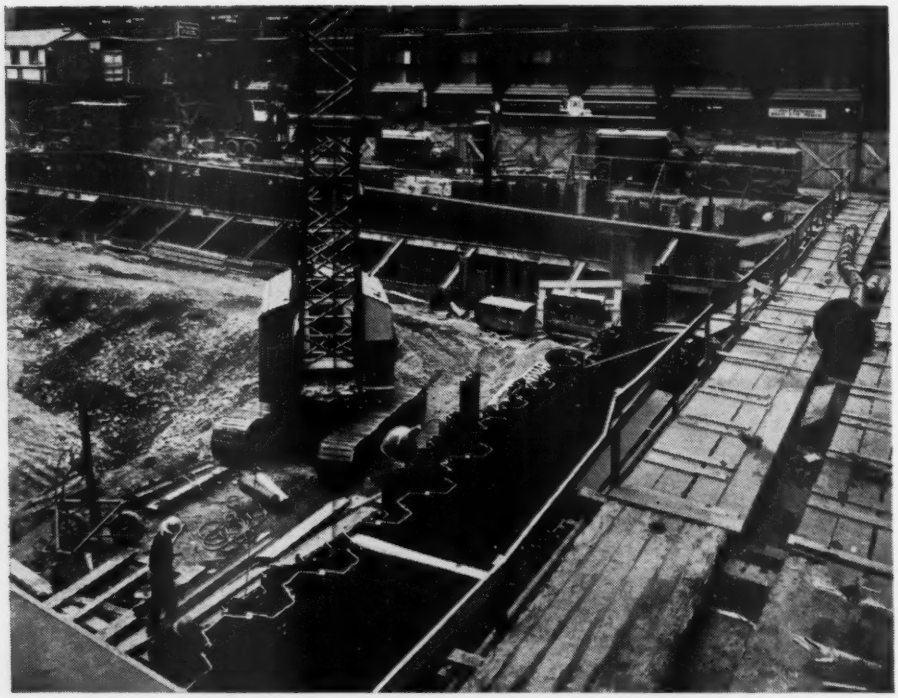
Nearness of the Mellon Bank Building caused the contractor some ticklish moments while excavating for the west wall was in progress. Because the latter's foundation was carried some 38 feet below that of the bank, it was necessary to underpin the structure. That was done successfully and in such a way that the bank carried on business as usual during the operation.

An interesting feature of the work was

CLOSE QUARTERS

Massing a large amount of equipment on a small plot flanked by tall buildings and bounded by busy streets is not an easy thing to do. The John F. Casey Company did it, as these pictures indicate. The view at the left shows the east side of the site. Casey's offices were erected on supports so as to utilize valuable space underneath them for parking automobiles and shifting equipment and supplies. The area between this passageway and the cofferdam is occupied by portable compressors, tool chests, supply sheds, etc. On the foundation site itself, a Lorain 25-ton crawler crane is seen scooping up material from the open cofferdam with a clamshell bucket and loading it into a dump truck for removal. In the background, a Northwest 20-ton crane on crawlers is lowering supplies to workmen in the cofferdam. One dump truck preparing to leave the lot, one concrete mixing truck entering it, and three trucks in the background chuting concrete into the cofferdam help to explain why traffic has to be directed inside the working area as well as in the bordering streets. The view at the right shows the west side of the site, next to the Mellon Bank Building. The timber ramp alongside the cofferdam enables the two Lorain Moto-Cranes on it to travel its full length. They hoist filled muck cans from the cofferdam and dump them in a clear space at the left of the ramp, from which the material is loaded into dump trucks by the crane seen in the background. The two portable compressors in the foreground are Ingersoll-Rand IK-315's. They supply air for work on the west foundation wall. Five other I-R portables, stationed at different points throughout the site, raise the total amount of compressed air available to the workmen to nearly 3000 cfm.





GOING DOWN

A Northwest crane shown scooping muck from the cofferdam area as excavation for the south wall of the foundation got underway. In the background are a Michigan truck crane and three of the seven portable compressors on the job. Clearly shown in this view is the sheet-steel piling that was driven to form the cofferdam walls. Having a trough-shaped cross section, the piling interlocks to form strong retaining walls between which workmen can safely carry on excavating operations. The ramp at the right was built so that trucks can deliver their loads of concrete when these operations begin.

the manner in which line holes were drilled along the wall adjacent to the bank. Because heavy charges of explosives could not be used there, line holes 24 feet deep and spaced 4 inches apart were drilled only 4 inches from the building by means of an Ingersoll-Rand JHM Wagonjack—a lightweight wagon-drill mounting which carries a DA-30 drifter. Easily positioned and operated by one man, it was well suited for work in such cramped quarters.

The depth to which the excavation had to be carried below street level averaged 90 feet; in some sections it reached the 100-foot mark. First, all material between the cofferdam walls was removed to a depth of 50-60 feet—the limit to which the piling was driven. From there square shafts, spaced along each side, were then sunk the remaining distance by means of Jackhamers and clay spades. Two men working in each hole dug the shale and hand-shoveled it into muck cans, which were hoisted by two Lorain truck-mounted cranes running on planks laid on the surface.

Each shaft, when carried to a suitable depth, is filled with reinforced concrete to form a section of the wall. Later, the material lying between the shafts will be excavated in a similar fashion and concreted so as to complete the wall all around up to the bottom of the steel piling. Concrete is brought to the site in ready-mix trucks and is dumped into funnel-top chutes placed directly over the shafts. Approximately 17,000 cubic yards will be required for the Casey contract, which includes the outside wall, 25 inner piers, and a pressure slab 2 feet 3 inches thick to be located 51 feet below street level.

Blasting operations are conducted with care so as not to endanger persons or property in the vicinity. By using light charges of dynamite fired at intervals by delayed-action caps, the company keeps vibration and concussion at a minimum. Woven-wire-rope blasting mats, lowered into position by cranes before the charges are set off, prevent damage from flying rock. Indicative of the caution exercised by the company is the fact that, although surrounded on three sides by sewer, light, telephone, and power lines, service of none of these utilities has been interrupted.

Because of the limited working area, materials cannot be stored on the building site. The stockpile is at the company's home office in Aspinwall, some 10 miles distant, and everything used on the job is kept there. If a steel beam is needed for a particular operation it is pulled from the yard and delivered by truck. In the same way, anything taken from the site is returned to Aspinwall.

Compressed air for drilling and other purposes is supplied by four Ingersoll-Rand 500-cfm. and three 315-cfm. portable compressors stationed at various points around the lot where their services are required. Water is removed from the excavations by I-R Model 25 and 35 sump pumps. These are operated by air and pump the water up to inclined troughs at the surface from which it drains into city sewer lines.

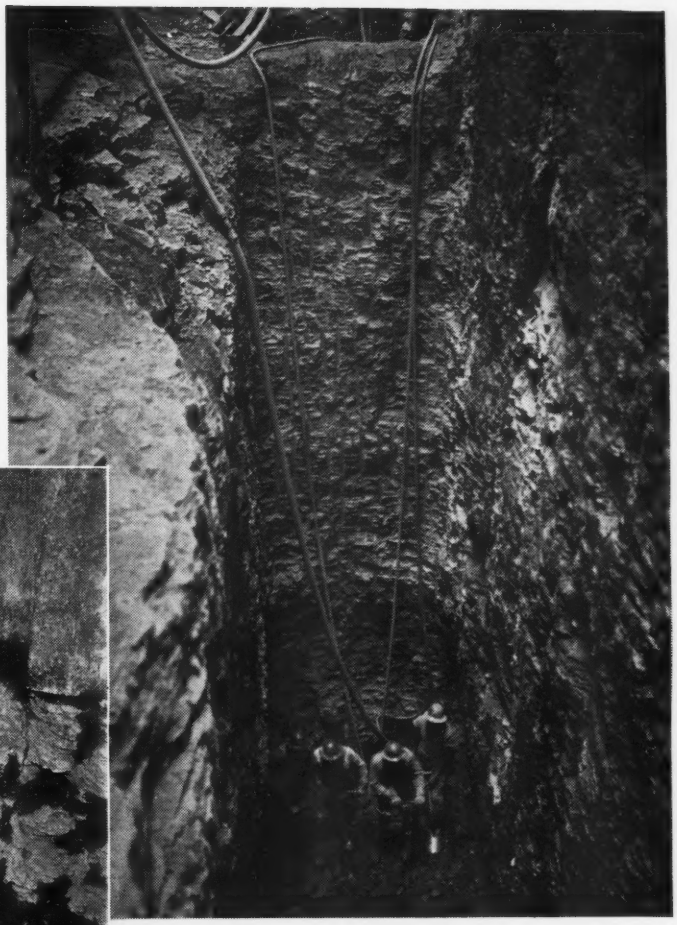
Work is being carried on 24 hours a day in three shifts. Approximately 400 men are employed, with 185 of them on the day shift. Floodlights fastened to the Mellon Bank Building, to a board fence surrounding the site, and to the company's elevated offices illuminate the scene of operations at night. Pittsburgh's citizens are keenly interested in what Casey is doing. When the contractor first moved on the job, passersby began to ask, and in some cases demand,

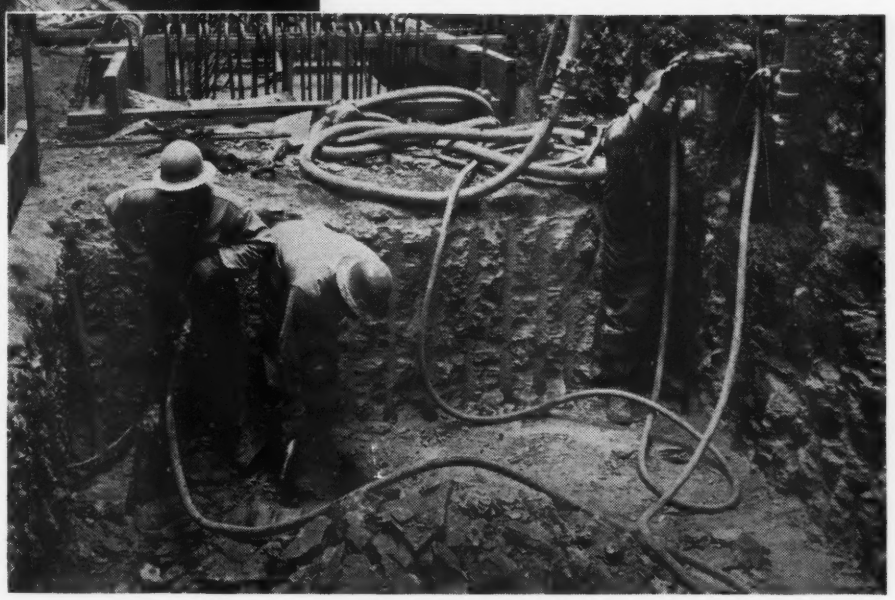
IN CHARGE

Left- Wm. H. Ruland, engineer on the job for Moran, Proctor, Freeman & Mueser, foundation engineers; center- Frank Scrano, job engineer for The John F. Casey Company; right- Jack Warner, superintendent for Casey.

DRILLING IN THE COFFERDAM

The view below shows one of two FM-2 wagon drills used to drill line holes for blasting. Lowered into the working area by crane, they are easily maneuvered. In the foreground is one of the shafts by means of which the lower part of the foundation wall is being built in sections. Another of these shafts is shown at the lower right in the initial excavating stage. The worker on the right is drilling close to the wall with a J-50 Jackhamer, and the one on the left is breaking ground with a PB-8 paving breaker fitted with a moil-point steel. In the background can be seen a shaft that has been carried to its final depth, provided with reinforcing rods, and concreted. Workmen are shown in the picture at the right nearing bottom along the east wall of the foundation. The shale is being broken with PB-8 paving breakers and hand-shoveled into a pile for removal by cranes equipped with clamshell buckets. An I-R Model 35 air-operated sump pump keeps the hole dry by pumping accumulated water to the surface some 90 feet above.





the right to see what's going on. He thereupon built two glassed-in observation booths on opposite sides of the area from which "sidewalk superintendents" can watch the cranes and other machines at work in comfort.

Three basements are to be constructed in the finished foundation. The floor of the lowest or third one will be the concrete pressure slab. It will house water heaters, pumps, and other equipment, and will also be provided with storage lockers. The second basement will be reserved for bank storage. A ramp running down to it from street level will enable armored cars and other vehicles to enter or leave the building. An air-operated turntable at the bottom of the incline will take each car as it comes in and point it towards anyone of the several loading platforms that happens to be unoccupied. Also on this level will be a sidewalk vault for parking cars and for storage purposes. A tunnel connecting it with the basement of the Union Trust Building on the opposite side of the street will give employees and officials quick access to either structure. The first or upper basement will be reserved for a cafeteria, employees' locker rooms, etc.

The total cost of the foundation work is 1¼ million dollars. The contractor broke ground on August 18, 1949, and the project is expected to be finished by April, 1950, when the steel framework of the skyscraper will begin to rise. The John F. Casey Company is carrying out the work under a subcontract from Turner Construction Company of New York City, contractors for the building.

S. L. Fuller is president of The John F. Casey Company, W. D. Allardice is manager of construction, and H. D. Cranston is purchasing agent. Jack Warner is superintendent on the job, Howard Gilkerson is assistant superintendent, and Frank Scrano is engineer. Wm. H. Ruland is engineer for Moran, Proctor, Freeman & Mueser, consulting engineers of New York City who are engineering the foundation. Architects of the building are Harrison, Abramovitz, & Cocken of New York City, who are represented on the job by John F. O'Brien.

1 Magnesium-bearing minerals have become important sources of industrial and household products. Among their many offspring are basic refractories for lining steel-plant furnaces, milk of magnesia, and tooth paste. Near Gabbs, Nev., the Sierra Magnesite Company mines brucite, a hydrated magnesium oxide. Two men are shown in one of the stopes, 30 feet above drift level, drilling holes for blasting down another block of ore. They are using Ingersoll-Rand R-48 Stopehamers.

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2 Blasts of compressed air perform helpful services ranging from blowing chips from metal-working machines to acting as the poor man's valet in whisking dust from his clothes when he comes off duty in certain types of work. An example of simple but effective blowing is illustrated here. Using a ¼-inch pipe with a flattened end for a nozzle, a worker is cleaning an expansion joint in a new concrete highway in Adams County, Mississippi, preparatory to filling it with a hot liquid-rubber sealing compound.

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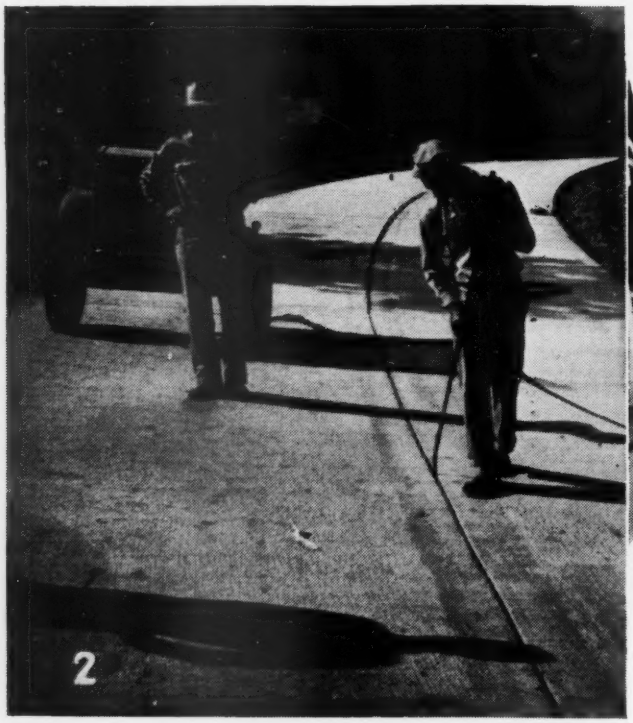
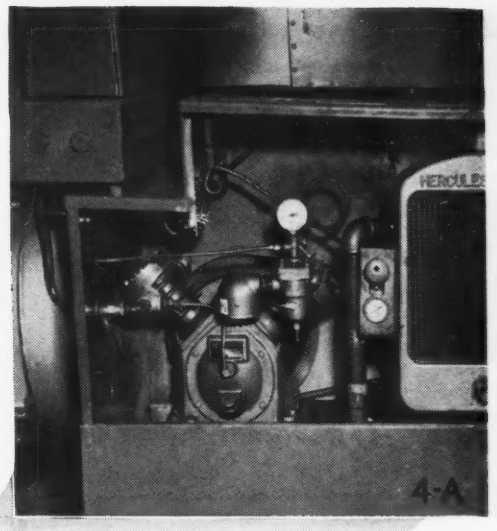
3 In assembling refrigerator cabinets, Westinghouse Electric Corporation's Mansfield, Ohio, plant uses a tiltable roller-conveyor section. When a cabinet reaches that point in the line the operator depresses a foot valve to elevate one end of the section through the action of a compressed-air cylinder and piston. That enables him to spot-weld the bottom pan in place without stooping or lifting the cabinet, which is prevented from moving down the slope by a spring-operated stop near the fixed end of the inclined section. When the welds are completed, the latter is lowered by the cylinder and the cabinet is carried along by the conveyor.

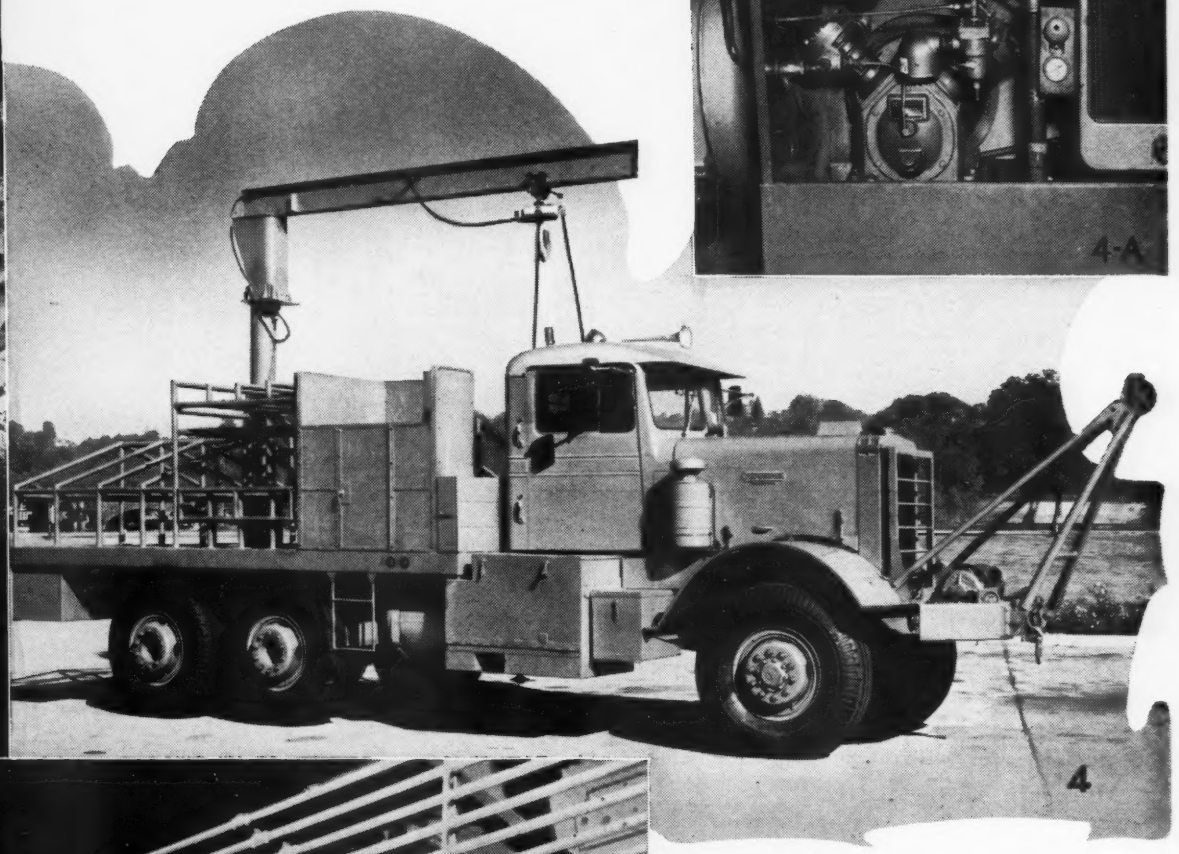
CATERPILLAR TRACTOR COMPANY PHOTO

"CONSTRUCTION METHODS" PHOTO

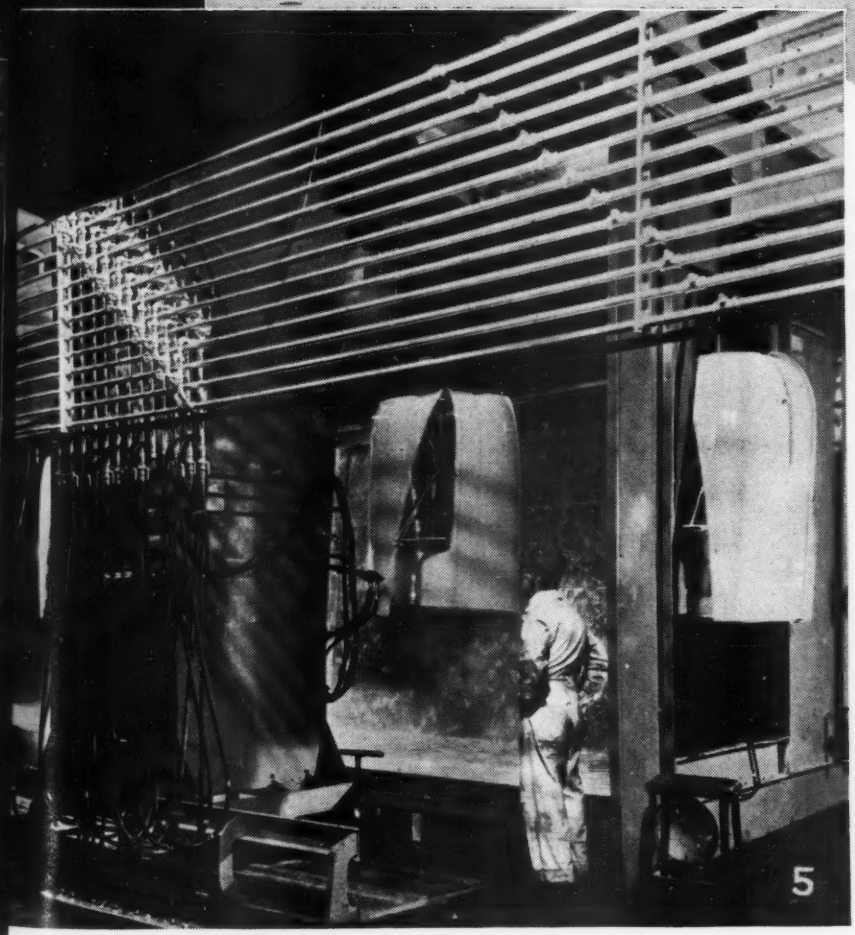


Compressed Air at Work



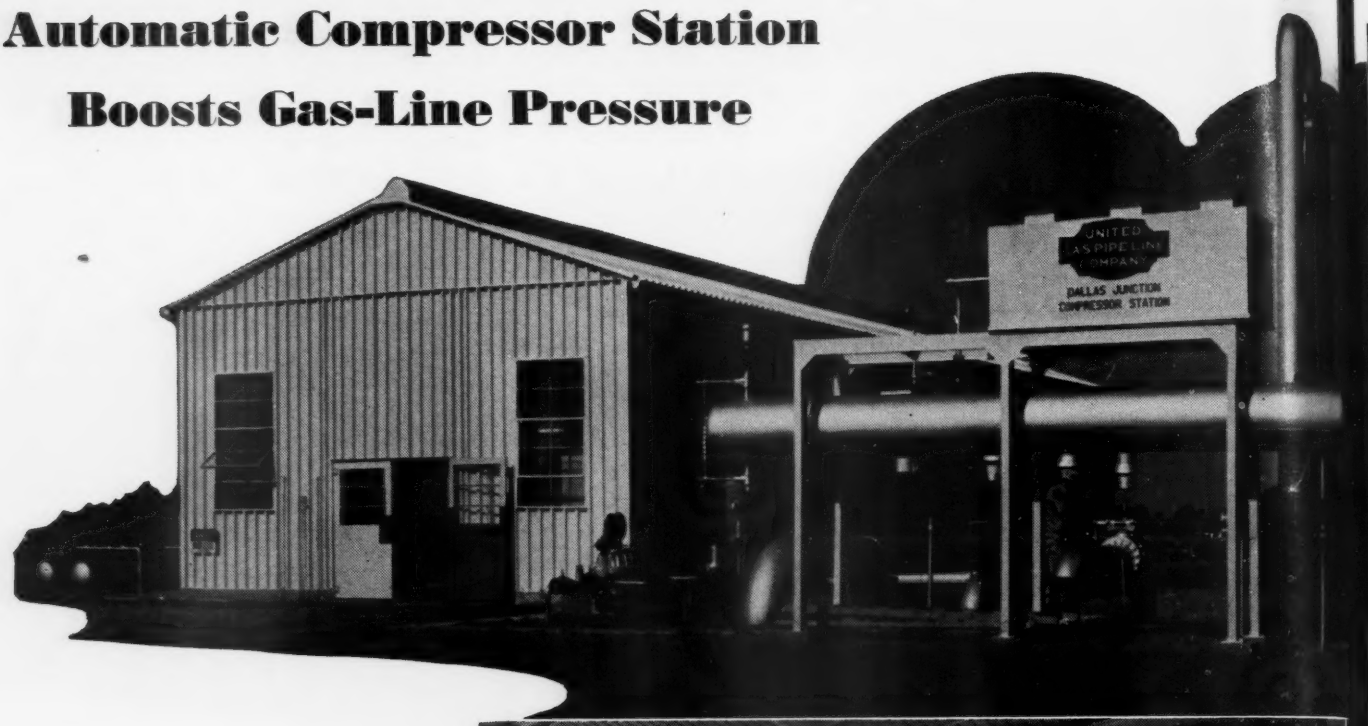


4 To service its motor trucks working in isolated foreign areas, Kenworth Motor Truck Corporation, of Renton, Wash., built the mobile trouble-shooter vehicle pictured. It carries a crew of three and, in the racks at the rear, spare tires. The latter are lifted off by an air hoist that runs on the overhead beam. An Ingersoll-Rand compressor driven by a gasoline engine (Number 4-A) occupies a steel cabinet under the near side of the cab. In addition to inflating tires, the air serves to operate the hoist and an impact wrench that is used in changing tires.



5 Automatic paint-spray equipment controlled by electronic devices is shown at work in the Nash Motors plant at Kenosha, Wis. The gun moves vertically and horizontally over the entire surface of automobile hoods to give them a coat of uniform thickness. The outfit even paints around corners to reach hidden areas. To do that, it is necessary to have an electric grid, carrying a high-voltage negative charge, behind the part and to spray paint, also carrying a negative charge, beyond the part towards the grid. The latter repels the paint, while the surface of the hood attracts it. The pipes and hoses shown are for paints of varying colors.

Automatic Compressor Station Boosts Gas-Line Pressure



Four Units Are Controlled so as to Cut in and Out of Service as Required to Maintain Ample Delivery of Gas to End of Line

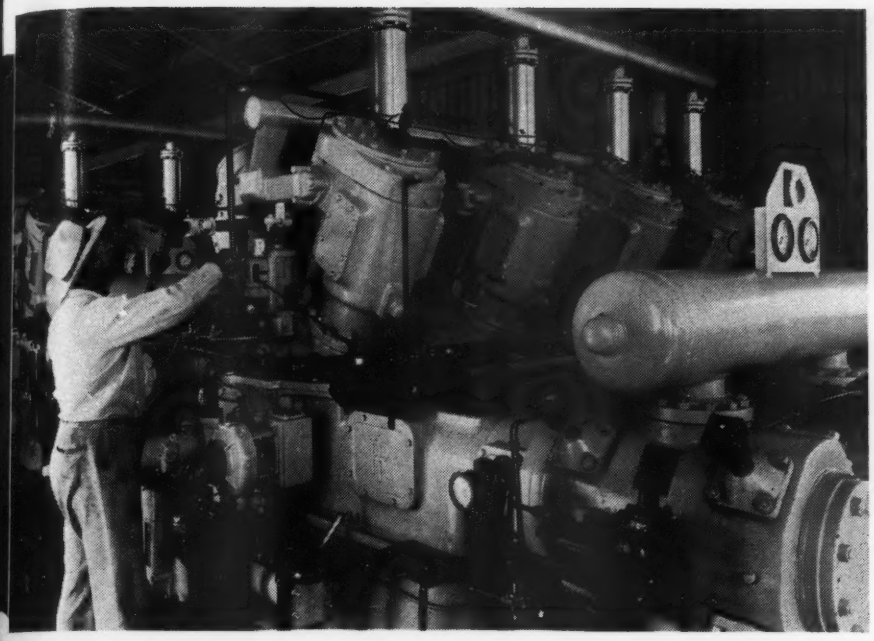
STATION AND COMPRESSORS

Housed in a metal building, top picture, four Ingersoll-Rand 300-hp. compressors have operated for more than a year on the United Gas Pipe Line Company's Mineola-Dallas Fort Worth gas line to maintain the pressure to Fort Worth at 200 psi. No attention other than routine servicing is necessary because the compressors go on and off the line automatically as the line pressure fluctuates. Two men, each working a 40-hour week, service the station.

ONE of the largest natural-gas producing and distributing concerns in the United States is the United Gas Pipe Line Company with headquarters in Shreveport, La. Its production facilities, pipe lines, and compressor stations are scattered from Brownsville, Tex., to Florida, and its highest daily sale of gas has reached slightly more than two billion cubic feet. In this vast operation, many compressor stations serve to boost the gas through long lines from points of production to points of use.

One of the company's pipe-line systems runs from Carthage, Tex., through Mineola to Dallas, and terminates at Fort Worth. It carries the industrial gas load of Dallas and, under contract, supplies boiler fuel for the electric generating stations of a power company in Fort Worth. The load on this line has increased at such a rate that the pressure between Dallas and Fort Worth during peak periods of withdrawal drops below the level required to insure delivery of enough gas to the latter city to meet its needs. The main-line pressure must then be boosted.

To accomplish this, the United Gas Pipe Line Company installed the Dallas Junction main-line compressor station. Because the machines are needed only intermittently, a conventional fully attended plant would have been uneconomical. To do the job, the company purchased four 300-hp. Ingersoll-Rand 8-XVG Beaird packaged units. Each has its own engine, a jacket water pump, radiator, fan, and oil filter. It is also equipped with a 3-way thermostat valve for the control of jacket-water temperature, a water-temperature shutdown switch, a low-oil-pressure switch, an overspeed switch, and a pressure speed control. These safety features adequately protect the engine against damage in case of trouble. This has been demonstrated in several instances, one of which was when a connecting-rod bolt broke. The consequent drop in oil pressure stopped the engine before the bearing opened sufficiently to do any harm.



PRESSURE REGULATORS CONTROL OPERATION

Intermittent compression of the incoming gas is controlled by a regulator and a 3-way valve attached to the compression cylinder at the bottom-right. Attached to the valve cover plates at each end and near the top of each cylinder are special discharge unloaders that are connected in alternate pairs to the 3-way vavle. They provide free-air unloading when the discharge pressure rises to 205 psi.

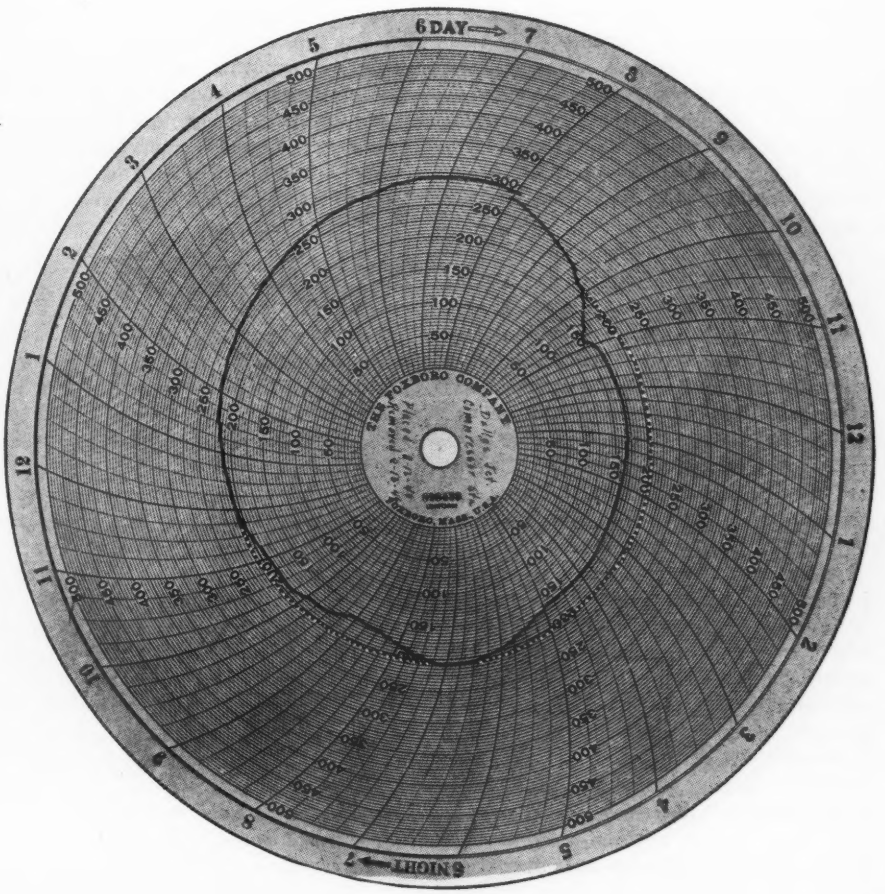
Only when higher discharge pressures are required to meet peak-load demands in Fort Worth do the gas compressors function. They go on and off without human attendance, although the engines run continuously whenever the station is in operation. Two men take care of servicing, clean-up, and yard work. They each put in a 40-hour, 5-day week, which gives them three days together for heavy maintenance work. The station is unattended from 4 p.m. to 8 a.m., and as the Sunday load is never heavy, it is shut down on that day.

An unusual feature connected with the sale of gas in the South is the fact that peak loads occur in summer instead of in the winter season. That is occasioned by the steadily growing use of air-conditioning apparatus during hot weather. The latter are operated by electricity or gas, and in either case increase the gas load. For that reason the Dallas Junction station carries its heaviest load in the summertime. During the winter months it is shut down completely.

After a full year of operation of the Dallas Junction station, it has been determined that a main-line discharge pressure of 200 pounds is sufficient to supply Fort Worth's requirements. In the early morning the main-line pressure at Dallas Junction is usually around 300 pounds. At that time the engines in the compressor station run at their minimum speed of 250 rpm. and two cylinders on each of them are completely unloaded. The third cylinder functions, but does not have enough displacement to create a differential because the flow of gas exceeds its capacity.

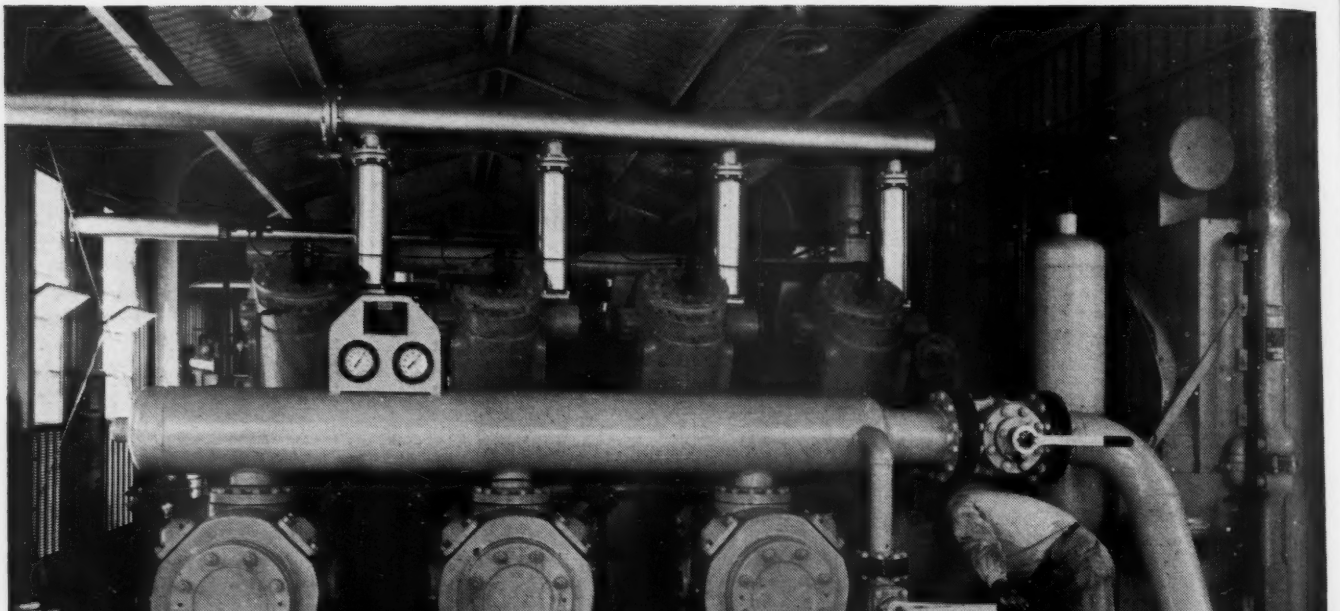
As more and more gas is used, the pressure in the line drops, and when it goes down to 210 pounds the engines start to speed up so as to increase the cooling-water flow and the fan speed before it begins loading. As the pressure continues to drop the compressors start loading, and when it reaches 202 pounds all units are running at their full speed of 350 rpm. As the demand for gas varies throughout the day, the discharge pressure is held at about 205 pounds. Consumption begins to drop off about 5 p.m., and on some days the compressors unload completely and then partially load again at nightfall when the lights go on. About midnight the load drops again until all units are unloaded. Then they float on the line at minimum speed until morning.

Each machine is equipped with three 9¼x12-inch compressor cylinders, and the four units have a total capacity of 2½ million cubic feet per hour at 150



OPERATING CHART FOR TYPICAL DAY

The solid line shows the incoming main-line gas pressure, and the dotted one indicates the pressure maintained by the compressors. The chart was placed in a Foxboro 2-pen recorder at 8 a.m. when the pressure was 275 psi. and dropping. At 10 o'clock, when gas withdrawals had reduced the line pressure to 200 psi., the compressors automatically cut in and boosted the outgoing gas to that level for the ensuing 8½ hours, during which period the incoming pressure fell to around 160 psi. Between 6 and 7 o'clock at night gas consumption declined and the compressors floated on the line. From 7 p.m. until midnight they were back in service, after which they were not needed.



COMPRESSION SIDE OF XVG UNIT

Each machine has three horizontal compression cylinders operated from the crankshaft of an 8-cylinder, V-type engine that runs on natural gas taken from the pipe line. Prior to being placed in service, each engine-compressor was equipped by J. B. Beaird Company with a radiator (at right end) to cool the circulating water and lubricating oil. Safety devices will shut down the machines in case they experience any ordinary trouble.

pounds suction and 200 pounds discharge. All compressor cylinders have two suction and two discharge valves on each end. The suction valves on two of the cylinders are designed for unloading when set for the desired maximum discharge pressure. Those at one end of the third cylinder unload at a minimum suction pressure of 150 pounds, which prevents overloading of the engine should the suction fall below that point.

The discharge-pressure unloaders were especially designed for this installation by Ingersoll-Rand Company because standard unloaders require a differential of about 30 pounds between discharge and intake pressure to operate. Standard free-air unloaders are placed under the suction-valve cover plates, while the new ones are attached to the outer side of the plates. The special type is really just a more sensitive device. It consists of a small cylinder the piston rod of which extends through the cover plate and holds the suction valve open when pressure is applied to the unloader. Control of the latter is effected by an I-R pilot-valve assembly that provides for 2-step unloading. When set for the desired pressure, this valve controls a 3-way valve which operates to admit 50-pound gas pressure to the unloader. Unloaders on opposite ends of the two cylinders function simultaneously, the two steps being about 3 pounds apart.

Minimum suction unloaders, which are operated by a Climax back-pressure controller and a diaphragm motor valve, hold the suction valves on one end of the third cylinder open until the main-line pressure rises to 150 pounds. Of course the other cylinders continue to compress gas, but with one end of the third cylinder taken out of play, the compressor is not called upon to handle a load exceeding the rated horsepower of the engines.

To insure against failure of the unloaders, which would result in excess discharge pressure during off-peak hours, a Mercoid pressure switch is connected to the discharge header. Should the pressure for any reason go beyond a predetermined point, the switch closes an electrical circuit and operates a solenoid valve on the station's fuel supply line. This stops all engines, and allows suction and discharge to equalize through the compressor cylinders. If the station is to be shut down about midnight, when the load has dropped off, the switch can be set to the desired pressure. Shut down will then be effected automatically, but gas will continue to flow through the compressors.

Each of the XVG compressors consists of an 8-cylinder V-type gas engine which drives horizontal compressor cylinders directly through a common crankshaft and connecting-rod arrangement. Because only three compressor cylinders are used, the opening for the fourth one normally provided is sealed off. Natural-gas fuel for the engines is supplied from the pipe line the station serves. To start the engines, compressed air is forced into the heads of the power cylinders until enough speed is generated to permit the spark plugs to ignite the fuel. Starting air is furnished by either of two 2-stage Ingersoll-Rand compressors, one driven by an electric motor and the other by a 4-cylinder Wisconsin gasoline engine.

Air is pulled in from the south side of the building and across the engines by the radiator fans and is exhausted through a short duct and louvers in the north wall of the structure. There are doors in the ducts so that some of the warm air from the radiators can be recirculated in cold weather to control the engine-room temperature. For the protection of the compressors, all incoming gas is forced through an oil bath in a Blaw-Knox gas scrubber, which remains in service whether the station is operating or not.

NEW ROCK TUNNELING RECORDS SET IN CALIFORNIA

George Foster's Crews Beat Marks Established in 1940 at Carlton Tunnel in Colorado

NEW rock-tunneling progress records for a shift, a day, and a month have been established at the Owens Gorge Project near Bishop, Calif. They supersede previous marks set at the Carlton Tunnel, Cripple Creek, Colo., in 1940. Comparative figures in feet, follow:

	Carlton	Owens Gorge
8-hour shift	27	41
24-hour day	74	104
31 days	1879	2442

All the records were made at the north heading of Tunnel No. 1, which is one of six faces being advanced. The record for a month covers the 31 working days from October 24 to December 2, the job having been shut down on Saturday afternoons and Sundays and also on Thanksgiving Day. The marks for a shift and a day were set on October 25. These advances surpassed previous ones established in Tunnel No. 3 during the 31 working days ended on October 1 (31 feet in a shift, 85 feet in a day, and 2204 feet in a month) all of which also exceeded the corresponding best performances in the Carlton Tunnel.

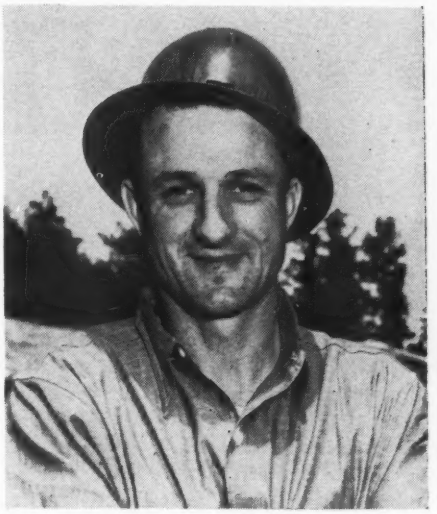
All the bores are being driven with carriages or jumbos, each carrying five Ingersoll-Rand DA-35 drifter drills provided with power feeds and mounted on 48-inch aluminum shells. Drills of the same type were used in the Carlton Tunnel. The project includes 55,984 feet, or slightly more than 10½ miles, of tunnels divided among five bores. Four of these will be on a slight grade, and one short one of 700 feet on a 45° slope. Tunnel No. 1 will be 30,590 feet long and is being driven from two headings. Lengths of the others, each of which is being advanced from a single heading, will be: 11,350 feet, 11,300 feet, and 2044 feet. Work has been underway since June 13, 1949.

The site of the tunnels is some 300 miles northeast of Los Angeles in a volcanic upland on the steep eastern slope of the Sierra Nevada. The prevailing rock is pink rhyolite, with lesser quantities of consolidated volcanic ash and andesite. The tunnel section is horseshoe-shaped, approximately 11½ feet in diameter in good ground and 12¼ feet where steel supports are required. The bores will be lined with concrete to a finished circular cross section 10 feet 1¼ inches in diameter.

Following are salient facts regarding the operations in Tunnel No. 1 during the record-breaking 31-day working period: Average daily footage, 78.77; total excavation, 11,061 cubic yards; average daily excavation, 356.81 cubic yards; best crew footage, 887. The 253 drilling and blasting rounds, averaging 31 holes each, resulted in an average advance of 9.65 feet. They were blasted with 29,627 pounds of 17-percent and 4160 pounds of 45-percent dynamite, an average of 3.055 pounds per cubic yard of rock broken.

Tunneling is being done for the Department of Water & Power, City of Los Angeles, by Owens Tunnel Contractors, a company formed for the purpose by four western contracting firms: Guy F. Atkinson Company, Bressi & Bevanda Constructors, Inc., David G. Gordon, and A. Teichert & Son, Inc. Vince Bressi is directing the work, with the title of managing partner. Lowell J. Wright is project engineer for the contractor and W. C. Mason for the City of Los Angeles.

George W. Foster, veteran tunnel driver, is general superintendent and has two assistants: William Harris, for tunnels, and A. M. Brown for electrical and mechanical facilities. Walking bosses at the heading where the most recent records were made are C. West, Henry U. Wood, and Howard Foster.



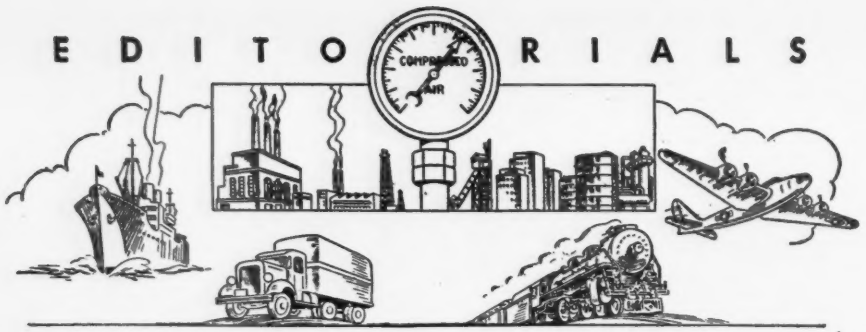
GEORGE W. FOSTER

General superintendent in charge of tunnel construction on the Owens Gorge Project. After learning rock drilling as a miner in his native Canada, he shifted into the construction field, working in tunnels in New York and South America. During 1941-42 he directed the driving of 8 miles of tunnels on the Apalachia Project for The Tennessee Valley Authority. In 1946-47 he was superintendent for Lowdermilk Brothers, contractors for the U.S. Bureau of Reclamation's Rams Horn Tunnel of the Colorado-Big Thompson Project in Colorado.

OWENS GORGE PROJECT

Locations of the tunnels and power plants being constructed by the Bureau of Water & Power, City of Los Angeles, are shown here. Up to December 6, approximately two-fifths of the 10½ miles of tunnels had been driven by Owens Tunnel Contractors. There will be three 37,500-kva. powerhouses operated as a unit by remote control. Estimated cost of the undertaking is $42,000,000.

EDITORIALS



DROUGHT IN THE EAST

FOR the first time in their lives, residents of New York City and other eastern drought-stricken areas are realizing that water is the most precious mineral on earth. After experiencing "bathless and shaveless" Fridays and having to request a glass of water in public eating places in order to get it, they are beginning to understand the true meaning of the word conservation. Heretofore, they thought of it only as a term Westerners use to describe conditions they know little about.

In the West, water shortages are, of course, an old story. New Yorkers have been consuming 125 gallons or more per capita daily. In Mesa Verde National Park, Colorado, unless conditions have changed recently, a guest at the government-owned hotel gets a small pitcher of hot water in the morning and it has to suffice for both shaving and washing. Cowhands have long carried canteens or canvas bags of drinking water with them, and even cans of tomatoes to slake their thirst. Old-timers in the Nevada mining camps such as Bullfrog recollect when the only water they had was pumped from the mines and used several times before being discarded. Boulder City, Nev., the government town that is now water-rich with Lake Mead near at hand, received all its potable water in tank trucks while Boulder Dam was being constructed. Parched Westerners could even believe the tales Dick Wick Hall used to write for the *Saturday Evening Post* about his pet desert bullfrog that was seven years old and couldn't swim. One day it jumped into a bucket of water and drowned.

New York's trouble is temporary. It stems from the fact that, in a constantly growing city, people have been consuming more water than ever before during an unusually dry period. The mighty Hudson River flows past the metropolis to the sea and can be developed as a source of supply. Other untapped sources are available at the headwaters of the Delaware. As an outgrowth of the current drought, dams will probably be constructed on that river to impound water which will very likely be allocated to New York City, Philadelphia, and various points in New Jersey. New Yorkers will, no doubt, also be taught to revise their water-using habits. Much wastage has come to light, including the use of tap water in mechanical cooling systems. Air-conditioning apparatus alone has been consuming large quantities for this purpose, operators having eschewed such conservation aids as spray ponds and heat exchangers commonly employed in the South and West.

This new water-consciousness along the eastern seaboard is being hailed by the semiarid West as the key to a better understanding of its long-standing chief problem. Henceforth, Westerners believe, there will be a more sympathetic reception of their appeals for dams and irrigation projects. Already, Southern California has reached the stage where it can absorb few more people unless it gets additional water. Similarly, the expansion of agriculture in most of the western third of the country hinges on extensions of the facilities for storing and distributing water. Public sentiment in the East will perhaps lean towards providing them.

NEW TUNNELING RECORDS

THE news, noted elsewhere in this issue, that California tunnel drivers have eclipsed previous records for speed is not, in itself, surprising. It is in the nature of human progress that better and faster ways of doing most things are continually being found. Yesterday's top performances in many lines seem mediocre by today's standards, and current best endeavors are certain to be improved upon tomorrow.

The really impressive thing about the new marks is the margin by which they exceed the old ones. While no one in the construction industry thought that the records set in the Carlton Tunnel in Colorado nearly ten years ago would stand up very long, it was not expected that they would be eclipsed as much as they have been at one fell swoop. Expressed percentagewise, the figures compiled by George Foster's Pacific Coast crews for progress in a shift, a day, and a month, exceed the previous ones by 52, 40, and 30, respectively.

It has been observed in these pages before that comparative figures on tunneling progress can be misleading because the many variables that affect the operating pace make it virtually impossible to find two tunnels where all conditions are identical. Consequently, statements regarding driving speed usually have to be qualified. A South African mining company lately claimed that it had advanced a heading faster than ever before at a particular depth below the surface. Actually, working depth affects progress because it increases the time required to get supplies to the drilling site and muck to the surface.

Generally speaking, a small bore can be driven faster than a big one, but even this statement is not always true. In fact, advance will be painfully slow if the opening is so narrow that only one man can work at the face. There is, of course, an optimum size that permits using manpower and mechanical aids most effectively. If the cross section deviates in any great degree from this "ideal," speed of penetration will be slower. Needless to say, all progress records have been established in tunnels of approximately the same favorable face dimensions.

Had it not been for what may be termed a technicality, Foster would have had the tunnel-driving crown three years ago. In the Rams Horn Tunnel in Colorado, where he was superintendent, he reported advances of 31½ feet in one shift and 80 feet in 24 hours on October 29, 1946, but was denied "official" recognition when an inspector refused to certify the figures because the final round had been blasted but not mucked out. No such shadow of doubt hangs over his latest performances, as the reports were affirmed by the project engineer on the job. Even if they had not been thus verified, there would have been no room for questioning the establishment of new records because of the margin by which past premier marks were surpassed.

At the time Foster thought he had set new records in the Rams Horn bore, he made some observations that he would no doubt still subscribe to. "We on the the job are very proud of the accomplishment," he said, "especially at this time when the general public opinion seems to be that there has been a serious letdown in the productivity of the man behind the mechanical equipment.

"So far as tunnel construction is concerned this is not true, because the same spirit of friendly rivalry exists today that existed when I first went to work in a tunnel. If those in charge of these projects will put the proper tools in the hands of the men, they will go on breaking records at every opportunity. We realize that conditions have to be right, the rock not too hard, no support necessary, no power failures, and that all the other causes of minor delays that tend to lower the average progress have to be eliminated. We also realize that the crews must be sparked to jump at and take advantage of perfect conditions when they arise."

Moles to Honor Herbert Hoover and R. E. Dougherty

HERBERT HOOVER

RICHARD E. DOUGHERTY

HERBERT HOOVER, former president of the United States, and Richard E. Dougherty, retired vice-president of the New York Central Railroad, will receive the 1950 annual awards of The Moles, New York organization of men now or formerly engaged in tunneling, foundation, or other heavy construction work. Both will be cited for their outstanding contributions to the construction industry and for their exemplary careers as citizens. The presentations will be made on February 9 at the tenth annual award dinner of the group.

In accordance with a custom inaugurated in 1941, the awards will be made to a nonmember and a member of The Moles. Mr. Hoover, a nonmember, will be honored for his "long career in public service, the example he has set in inspiring the ideals of individual enterprise and personal freedom, and for his accomplishments in the engineering profession." Mr. Dougherty, a member, will receive recognition for his lengthy service as a railroad engineer and executive and for participation in public affairs in New York City and his home community of White Plains, N. Y.

Herbert Clark Hoover was born in West Branch, Iowa, on August 10, 1875, the son of a blacksmith. Both his parents died before he was ten years old and he was raised by Quaker relatives in Oregon. He was a member of the first class to be graduated from Leland Stanford University in 1895, having earned most of his undergraduate expenses. He was schooled as a geologist and mining engineer, but his first job was as a laborer in the Mayflower Mine in California.

After working as engineer and geologist for mines in Colorado, New Mexico, Arizona, and Nevada, he went to Western Australia in 1897. Outstanding work in the gold fields there led to his appointment in 1899 as chief engineer of the newly established department of mines of the Chinese Government. Returning to America, he married Miss Lou Henry, with whom he had attended college, and the couple departed immediately for China.

Mr. Hoover left China in 1901 and spent the next twelve years in Australia, Russia, Burma, Italy, Central America, and other foreign countries as a consultant on mining problems. During this period he maintained offices in San Francisco, New York, and London and became managing director of several of the concerns for which he did work.

Mr. Hoover's role as humanitarian began in 1914 in London, where he was on a mission for the Panama-Pacific Exposition. The outbreak of World War I having stranded thousands of Americans there through their inability to cash checks or letters of credit, Mr. Hoover and a group of engineer friends pooled their resources, cashed checks, arranged hotel and steamship accommodations, and otherwise assisted more than 150,000 of their countrymen, most of whom they did not even know, to return to their homeland.

Following this voluntary action, Mr. Hoover was asked to assume the task of getting relief to ten million starving Belgians and Frenchmen who had been cut off by the invading German armies. Overcoming almost insuperable obstacles, he organized the Commission for Relief in Belgium, arranged with the warring nations to transport food and clothing through the blockade, and raised the necessary funds from individual donations and advances by the governments of France, Great Britain, and the United States. During the next four years the Hoover-directed commission sent into occupied Belgium and France some five million tons of food and clothing. That work brought Mr. Hoover world-wide acclaim and launched him in his subsequent career of statesman and humanitarian, the details of which are so well know as to require no review here.

In discussing the selection of Mr. Hoover for an award, Carlton S. Proctor, Moles' president, said: "Our immediate incentive for honoring Mr. Hoover is in recognition of his priceless service as chairman of the Commission on Organization of the Executive Branch of the Government. The commission . . . has recommended the many sweeping reforms that are so urgently needed to increase our government's operating efficiency and reduce unnecessary expenses."

Richard Erwin Dougherty was born in New York City on February 13, 1880, graduated from the College of the City of New York, and received a civil engineering degree from Columbia University in 1901. After teaching at Columbia for a year he took a job as rodman in a New York Central surveying crew, thus beginning an affiliation that has endured for nearly 50 years. He was advanced to assistant engineer of the Mohawk Division in 1902, and then to a similar position in the general office in New York in 1904. From 1910 to 1918 he was in charge of construction in the railroad's eastern district, after which he spent six years as designing engineer for that part of the system in and east of Buffalo. He became assistant vice-president in 1924 and engineering assistant to the president two years later. In 1930 he was named vice-president in charge of improvements and developments, a post he held until his retirement in 1948. He still serves the New York Central as a consultant. He is a past president of the American Society of Civil Engineers.

Concerning the selection of Mr. Dougherty for an award, Mr. Proctor said: "As principal engineering executive of the New York Central, Mr. Dougherty has made special contributions to both railroading and civil engineering in America. In addition . . . to furthering the growth and value of his company, he has given his time unselfishly to improve public transportation through his efforts in removing grade crossings, improving terminal and station facilities, in promoting safety, and in city and port planning. . . . His unusual talents have been amply recognized through leadership in professional societies. In choosing Mr. Dougherty, we do so with the intention of rewarding his efforts with the most cherished of prizes—the admiration and esteem of fellow workers."

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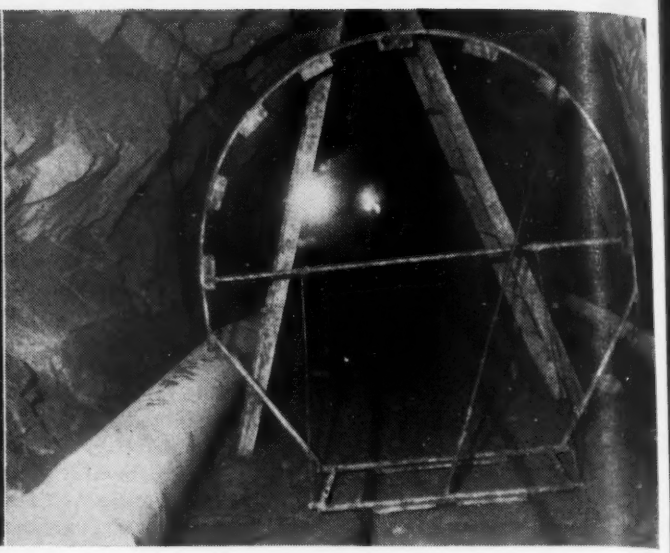


VIEWS IN TUNNEL

The marking device is pictured above, set up for use. The other view shows native drillers with one of the Stopehamers that put in the blast holes to enlarge the section.

Marking Device Speeds Tunnel Enlarging

ENLARGING a small-diameter tunnel by means of the ring-drilling method calls for accuracy in putting in the blast holes if overbreak is to be held to a minimum. Furthermore, elimination of guesswork as to their direction and depth makes the work go faster—cuts costs. For this reason many contractors and mining men engaged in operations of this kind lay out and mark the location and depth of the holes in some way before ring-drilling starts.

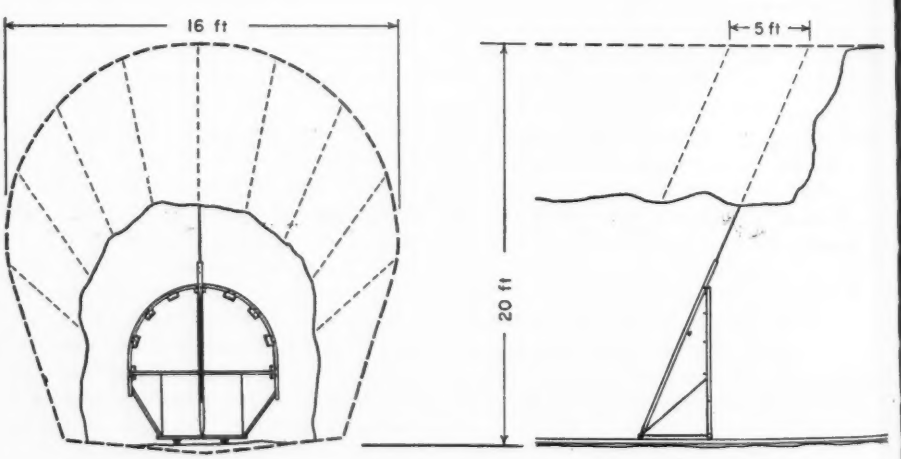
J. Waerum, tunnel superintendent for the construction firm of Christiani & Nielsen of Copenhagen, Denmark, successfully used a marking device of his own design in enlarging a section of the Moyopampa Tunnel, which is a part of the Salto Moyopampa Hydroelectric Project now underway in the Peruvian Andes. It will take water from the Santa Eulalia River near the town of Chosica, 25 miles northeast of Lima, and deliver it to a power plant 8 miles away. (The entire undertaking was described in our April, 1949, issue.)

The marker of Waerum's apparatus consists of a piece of metal pipe containing a metal rod that is free to slide and has a small paint brush fastened to the upper end. A thumbscrew permits clamping the rod at any point in the pipe, part of which is cut away so the rod can be seen. The rod and pipe are scaled so that when the former is extended or retracted the distance from its tip to the far end of the enclosing pipe can be read.

The framework that holds the marker is made from welded metal pipe in two sections that are hinged together. The top half is semicircular and has nine divisions, each with two short lengths of metal rods or stops projecting from the pipe to keep the marker rod in place. A metal plate welded below the stops gives the distance from the base of the device to the proposed tunnel breakage line. Hooked brace rods hold the two sections apart at a 90-degree angle when the apparatus is in use and permit the frame to be collapsed for easy handling.

In the Moyopampa Tunnel, the device was carried by hand to the location where it was to be used and set up on rails on the tunnel floor. With paint on the brush, the pointed end of the marker was inserted in a holder in the base of the framework, with the upper end between the stops of one of the divisions. The thumbscrew in the pipe was then loosened and the rod extended until it touched the tunnel wall or roof, the brush marking the spot. The length of the rod was next read and that figure subtracted from the distance marked on the plate at that division, the difference between the two being the depth to which the hole had to be drilled to bring it to the proposed breakage line. The footage was then painted on the rock surface alongside the location mark. When this procedure had been repeated at the other divisions the apparatus was folded up and moved along to the next drilling place.

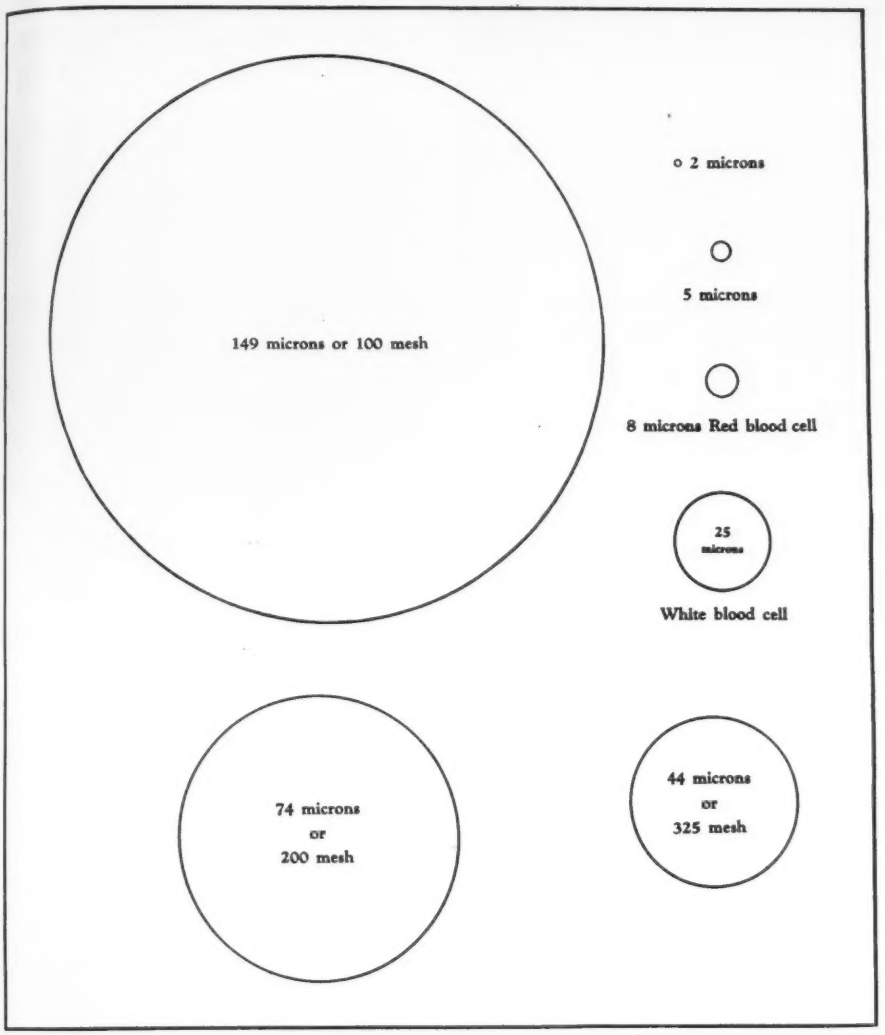
Drilling was done from a wooden plank or platform with an Ingersoll-Rand R-58 Stopehamer and 2-inch, Series 13 stud-mounted Jackbits, the men merely setting the machine on the spot where the lower end of the marker had rested, starting each hole with the bit on the paint mark, and drilling to the depth designated. Mr. Waerum reports that results obtained were highly satisfactory, with minimum overbreak.



HOW IT WORKS

The sketch at the left shows how the marking device projects the course of the holes used in ring-drilling to enlarge the tunnel. At the right, the apparatus is seen from the side.

New Conceptions of Smallness



COMPARISON OF SIZES

The circles represent particles of the sizes marked, each magnified 500 times. Particles less than 44 microns in size cannot be seen by the unaided eye, and truly colloidal particles are not visible when magnified 1000 times.

HOW small is small? Well, it is getting smaller all the while, at least in the realm of commercially applied materials. It has been possible for some time to reduce substances to particles in the micron range, but such fine grinding has not been widely employed in industry because of its cost and other unfavorable factors. In recent years the use of steam and air jets for attrition grinding has opened the way to finer pulverization than is ordinarily economical with the usual ball or other type of mill. Moreover, the method has added advantages: the materials produced are free from contamination such as is caused by conventional grinding devices, and their range of sizes is closely controllable.

As between steam and air power, the latter is being applied increasingly for grinding purposes. No moisture problem is involved, and heat-sensitive substances, which have previously been difficult to reduce, can be successfully pulverized even by means of refrigerated air if necessary. A greater percentage of the final product is also recovered because it is easier to separate the particles from air than from steam.

Attrition grinding with air results in materials that, in many cases, are more effective than those now in use and that will have a wider field of application. A few examples are given to show just what is accomplished through better pulverization: pharmaceuticals such as penicillin are more potent when finely ground, and their effect may last longer; insecticides like DDT and sulphur go farther, kill faster, and stay put longer when the particles are small; paint pig-

UNIT	in.	mm	μ	mμ	Å	μμ	x-u
1 in. (inch)	1	25.4	25400	2.54×10^{7}	2.54×10^{8}	2.54×10^{10}	2.54×10^{11}
1 mm (millimeter)	.0394	1	1000	10^{6}	10^{7}	10^{9}	10^{10}
1 μ (micron)	3.94×10^{-5}	10^{-3}	1	1000	10,000	10^{6}	10^{7}
1 mμ (millimicron)	3.94×10^{-8}	10^{-6}	10^{-3}	1	10	1000	10,000
1 Å (angstrom unit)	3.94×10^{-9}	10^{-7}	10^{-4}	0.1	1	100	1000
1 μμ (micromicron)	3.94×10^{-11}	10^{-9}	10^{-6}	10^{-3}	0.01	1	10
1 x-u (siegbahn unit)	3.94×10^{-12}	10^{-10}	10^{-7}	10^{-4}	10^{-3}	0.1	1

TABLE OF EQUIVALENT LINEAR MEASUREMENTS

Scientists and technologists have developed a new system of measurements in order to express the size of ultrafine particles in the screen, subscreen, and submicroscopic ranges. Table shows comparative values of the units used.

ments and fillers cover greater surfaces—spread more readily; and there is less spoilage in the case of end products obtained when porcelain and ceramic clays are reduced by the air method of attrition.

The particles we have in mind for these applications range in diameter from 20 to 2 microns. A micron is 1/1000 of a millimeter, or about 1/25000 inch. To illustrate just what this means in actual size, the accompanying comparative tables and chart are reproduced by courtesy of The Micronizer Company, New York City.

The chart is based on 500 magnifications of actual sizes. Note that the 44-micron particle is actually close to the smallest that is visible to the naked eye. Then compare that with the 5- and 2-micron particles that are in fairly common use today in many products. Particles even smaller than 1/500 of the size of the tiniest circle on the chart can now be ground commercially. Yes, small is, indeed, getting smaller.

EDITOR'S NOTE: An article in our February issue will describe a commercial application of the pneumatic grinding process referred to here.

Material	Approximate Size Limit	In Å Units
Proton	2×10^{-6} μμ	0.00000002
Electron	38×10^{-4} μμ	0.000038
Cosmic Ray	5×10^{-2} μμ	0.0005
Shortest X-Rays	6 μμ	0.06
Diameter of Hydrogen Atom	1.08 A	1.08
Longest X-Rays	8 mμ	80
Colloidal Particles	2-100 mμ	20-1000
Lower Limit of the Microscope	100 mμ	1,000
Wave Length of Violet Light	400 mμ	4,000
Wave Length of Red Light	650 mμ	6,500
Bacteria (cocci)	2 μ	20,000
Red Blood Cells	8 μ	80,000
White Blood Cells	25 μ	250,000
Lower Limit of Visibility (naked eye)	40 μ	400,000
325 Mesh opening	44 μ	440,000
Diameter of Human Hair	50 μ	500,000
100 Mesh opening	149 μ	1,490,000

TABLE OF RELATIVE SIZES

Comparison of sizes of small particles. Note that only those comprising the three lower items on the list are visible to the naked eye

Air-Conditioning System Cools Aggregates for Concrete Spillway

THE cooling of concrete in building huge structures such as dams to reduce shrinkage cracks to a minimum is fairly common practice today in the United States, but the methods of refrigeration are still undergoing change. The subject has been followed closely in these pages and covers the use of cold water circulated through pipes embedded in the concrete, supplemented by concrete mixed with chilled water or ice and by refrigerated sand and aggregates.

In the case of Bull Shoals Dam, now under construction, the aggregates are treated by the inundation process—that is, by immersing them in large steel tanks through which water at 35°F. flows at the rate of 2000 gpm. in a closed cycle. The sand, which has to be kept dry, is cooled by equipment based on the heat-exchanger principle. It descends by gravity through vertical tubes which are mounted in two cylindrical tanks and surrounded by water, also at a temperature of 35°, flowing upward.

An entirely different method of aggregate precooling is in service at the Harlan County Dam, a flood-control and irrigation project underway on the Republican River near Alma, Neb. It consists of a 12,000-foot rolled-fill embankment with a concrete spillway 1350 feet long. The structure will require the use of 430,000 cubic yards of concrete, which is being mixed with chilled water and aggregates reduced to a freezing temperature by an air-conditioning system.

Four sizes of aggregates are used and stored in bins on top of the concrete plant. In a building at the base of that structure is the air-cooling installation made up of nine compressors, with a combined rated capacity of 470 tons, and of an evaporator bank of direct expansion coils with a total face area of 360 square feet. The latter are housed in an insulated room, together with four pressure blowers that draw the air through the refrigeration coils and force it through as many 36-inch corrugated pipes into the bins. It enters them by way of louvers in the bottom, flowing upward through the aggregates to a common plenum chamber above the partitions that divide the bins. A 72-inch duct returns the air to the cooling plant.

One of the desirable features of the air-conditioning system is that it can easily be changed over into a heating plant for winter operations. This is done by blowing warm air from two farm-type dehydrators through the aggregate bins. By November, 1949, a total of 180,000 cubic yards of concrete for the spillway had been placed, and even though the weather ranged from 35 to 104°F. in the course of the operations the temperature of the mix at the time of pouring into the forms did not exceed the maximum of 65°F.

Calls Drag Chains on Gasoline Trucks Worthless

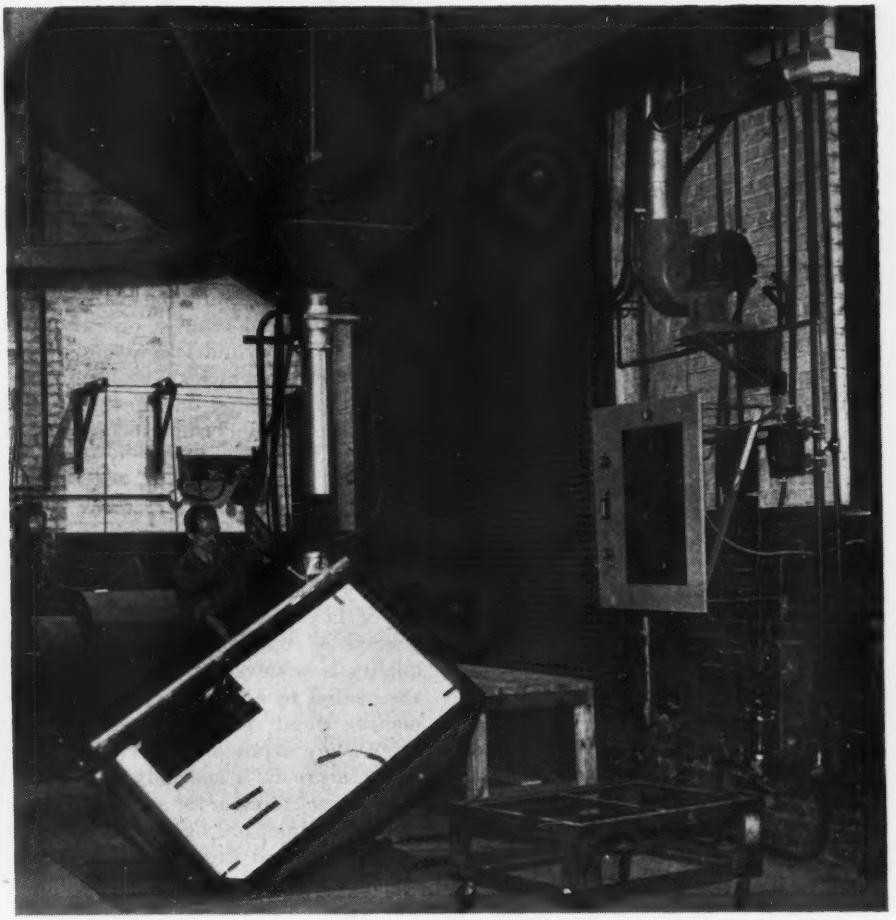
DRAG chains on gasoline trucks do not, as is commonly thought, provide a safeguard against fires caused by static electricity, says James E. Hill, training and safety supervisor of the Union Oil Company of California. Referring to a statement in an article in our November issue (*Probing the Secret of Lightning*) in which such a function is attributed to these chains, Mr. Hill writes:

"This is a popular misconception, held by even otherwise well qualified persons. Actually, the chains or, latterly, straps of conductive leather, are dragged in compliance with outmoded and unjustified regulations and ordinances and have no real value. The more widely the facts are known, the sooner we may expect legislation to prohibit, rather than require, these worthless nuisances."

An article setting forth the reasons why drag chains are unnecessary and backed by authentic studies and experiments was sent us. It was prepared by C. H. Van Marter, one of Mr. Hill's associates, and has been published in recent months in *National Safety News, California Fireman, and Western Motor Transport.* It concludes as follows:

"Authoritative national bodies recognize the fact that drag chains are ineffective in the four possible situations in which a tank truck may be found (in storage, in transit, loading, unloading). Two states have passed laws prohibiting the use of drag chains and have had no increase in tank-truck fires traceable to their non-use. Years of experience by the petroleum industry demonstrate that drag chains have no place in flammable liquids tank truck fire protection."

Pneumatic Equipment Packs Insulation in Cabinets



FILLING APPARATUS

Special equipment, right, placing Santocel insulation in a deep-freeze cabinet while the latter is jolted by machinery beneath the floor level. The Santocel is supplied from the large overhead bin, and operating controls and gauges are on the right wall. Details of the special hose connection for inserting the insulant are shown above. The smallest hose carries compressed air for actuating the four segments of the diaphragm in the large hose opening to control the flow of the material into the cabinet. Through the hose at the left, either pressure or vacuum is applied to the cabinet to speed up the filling operation.

COINCIDENT with the introduction of a new kind of free-flowing, space-saving insulating material called Santocel, the Monsanto Chemical Company has developed special equipment to facilitate putting it in place. Designed by engineers of its Merrimac Division, the equipment makes use of both compressed air and vacuum in packing the insulation in the wall spaces of completely fabricated refrigerator and deep-freeze units.

Santocel is a silica aerogel in the form of fine, white powder. It is chemically inert and fire-resistant, and has excellent flowing properties. Claimed by the company to be "the world's most efficient insulation," it has an extremely low rate of heat conductivity that permits considerable reduction in the thickness of wall sections in which it is used. For instance, the capacity of a standard 4-cubic-foot home freezer recently used to demonstrate the new filling equipment was increased to 7 cubic feet by reducing the thickness of its walls from 4 to 2 inches.

A freezer or refrigerator cabinet designed to utilize Santocel insulation is first manufactured as a complete unit that is totally enclosed except for a small opening near one corner. The cabinet is then placed on a hydraulic jolter with the opening uppermost. A supply pipe leading from an overhead bin containing Santocel is attached to the opening in the cabinet by means of a special connection containing an air-operated diaphragm-type valve to control the flow of the material. The connection also has separate passages by means of which either pressure or vacuum can be applied to the cabinet as desired through a rubber hose. Both the pressure-vacuum apparatus and the air-operated valve are actuated by controls grouped near the jolter.

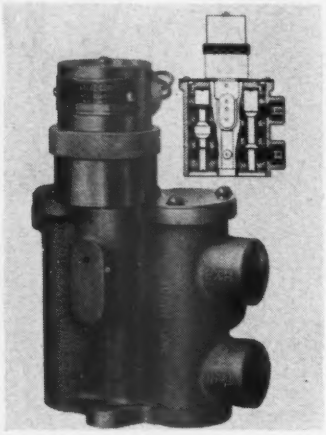
As soon as the jolter has been started, the vacuum valve is opened slightly to remove dust from the cabinet, as well as air displaced during the filling operation. Next, the air-operated valve is opened to allow Santocel to flow into the cabinet. The free-flowing properties of the material enable it to reach all parts of the cabinet in spite of obstructions such as angle irons, coils, or supports for the inner liner.

When the cabinet is approximately half full, the valve is closed and air at a pressure of ¼ to ½ psi. is applied to bulge the sides and permit the Santocel to settle, the pressure of the air helping to compact the material. The entire procedure is then repeated two or three times until the cabinet is filled. Finally, the diaphragm valve is rapidly opened and closed several times, this action causing the valve to act as a piston to force an extra quantity of Santocel into the cabinet. The clamp holding the valve to the cabinet is then removed and a metal cover plate slid over the opening and fastened down on the fully insulated unit.

Establishment of a Division of Fire Technology, the first of its kind in the United States, has been announced by Dr. Harold Vagtborg, president of the Southwest Research Institute of Houston and San Antonio, Tex. A nonprofit organization, it will put its staff and facilities—laboratories and a 4000-acre ranch where full-scale tests are made—to work on the problems of fire protection, prevention, and control. Its services are of a scientific nature and will be available to industries exposed to fire or explosion hazards; equipment, instrument, and extinguisher manufacturers; storage and warehousing companies; civic fire-fighting groups; and all government agencies responsible for the protection of forests, mines, military and naval establishments, etc.

Industrial Notes

Compressed air, water, and light oils can be handled by a 4-way, solenoid-controlled valve of new design announced by the Crescent Valve Company. Known as the Model 1044, it is rugged and fast-acting and may be actuated continuously at any speed up to



600 cycles per minute. Has been operated at 1800 cycles it is claimed. It is available for two air-line pressures: 0 to 50 psi., and 30 to 150 psi. The two main valve members are in vertical alignment with two parallel bores in the body. They move up and down simultaneously to open and close their respective inlet and exhaust ports. There is no neutral "open" or "closed" position. Body is made of cast bronze, full ported, with screwed pipe connections; internal parts are of brass; the main valve seats are of special-composition rubber molded to brass inserts; and the pilot plunger and ball valve are of stainless steel. Solenoids are of special design. Power consumption: 21 watts alternating current and 22 watts direct current.

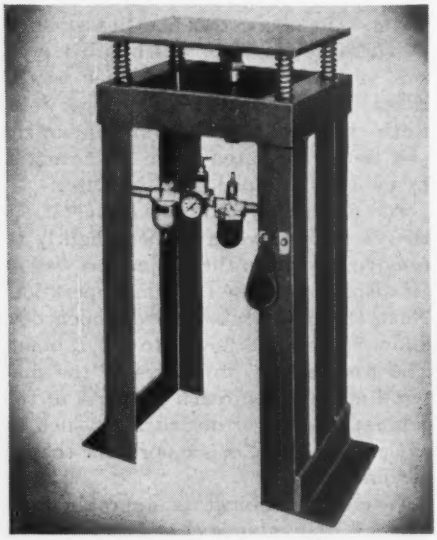
Windows can be kept shut during application of a line of paints put on the market early this year by Keystone Paint & Varnish Company. Included are primers and flat, eggshell, and gloss paints, all of which are said to be odorless to permit year-round painting without the all-pervading sickening smell. Solvents and binders are the offenders. The new products are mixed with a solvent produced by the petroleum industry and with Keystone's own binder, both odorless.

Portable welding booths with walls of vinyl-coated cloth woven of Fiberglas are something new and are said to have numerous advantages over metal enclosures. The fabric is hung to within an inch of the floor in overlapping panels from a rod frame and is weighted at the bottom to prevent flapping. The curtains can easily be pushed aside to admit work from any angle of approach and of any size the booth can accommodate. The cloth, called Fibrylon, is durable, noncombustible, and resistant to mildew and most acids and alkalies.

To protect Westinghouse jet aircraft engines from the harmful effects of moisture and jarring in transit, each is packed in a steel shipping shell in which it is bolted and cradled on rubber air springs. The cylindrical casing is made in two sections which are sealed airtight, is pressurized, and mounted on skids with special rubber-air spring suspension.

No sharpening for the first three years, that is the claim made for stainless-steel knives now being produced by Robeson Cutlery Company, Inc., by a secret process of heating and freezing. The sequence of operations by which this quality is achieved is as follows: blades are heated to a temperature below the melting point; are quenched in oil at 140°F.; are exposed to extreme subzero temperature in a specially constructed deep-freeze chamber for a predetermined length of time; are again heated to relieve strains and stresses; and are finally cooled to room temperature for tempering. It is claimed that the product outlasts any other cutlery on the market.

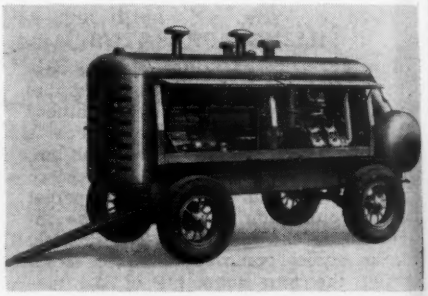
Compressed air powers a new vibrating table announced by The Cleveland Vibrator Company. The unit is recommended for packaging small parts and granular materials of all types, for settling semithick liquids and molds, and for similar work. It features a solid ½-inch steel platform suspended on heavy steel springs to prevent transmission of the vibrations to the floor. A knee valve is used to actuate the oscillating mechanism, and the operator can control the intensity of the vibrations by a pressure regulator. Standard equipment in-



cludes an air-line filter and an air-line lubricator, which is said to insure long trouble-free service. The maximum operating speed is 1950 vibrations per minute and is obtained on a line pressure of 80 psi., at which the air consumption is 8½ cfm.

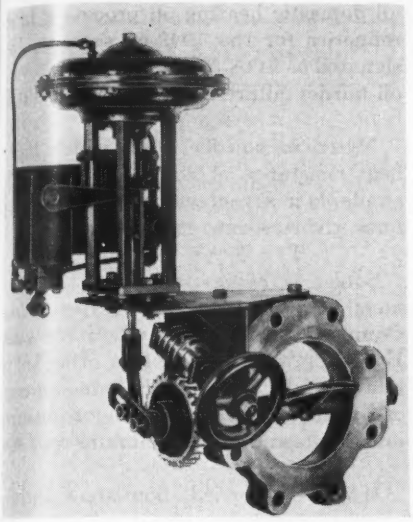
Parts made in pressure die-casting machines are easily ejected, it is claimed, if the dies are coated with Die Slick No. 9, a product of G. W. Smith & Sons, Inc., 5401 Kemp Road, Dayton 3, Ohio, which is offering a free sample. Applied by brush or air spray, the compound is nontoxic, causes no objectionable smoke or fumes, and leaves no carbon, gum, or other residue on surfaces. It is especially recommended for use in the production of zinc-alloy castings that are to be plated.

Ingersoll-Rand Company has announced the adoption of full diesel-engine drive for its 500-cfm. Mobil-Air compressor. The engine is the well-known International Harvester heavy-duty UD-24 which starts as a regular gasoline engine and, after a short warm-



up, is shifted to full diesel by means of a single lever. Rated at 100 psi. pressure, the compressor is equipped with the company's floating-speed Drill-More regulator to keep it at the lowest speed that will hold the pressure. Other features of the unit are: two-stage air-cooled compression, hydro-shift Flex-Disc clutch, channel valves, and an easy-to-service air cleaner. The manufacturer, who introduced the first 500-cfm. portable in 1939, also supplies the machine with a Waukesha heavy-duty gasoline engine.

A new line of air-operated butterfly valves for process control is offered by the Fischer & Porter Company in sizes from 3 to 12 inches. Advantages claimed are great strength, lightness, compactness, convenience, and accessibility. Entire assembly is installed with one set of through bolts. Valve bodies are available in carbon steel, bronze, 316 stainless steel, and other materials including plastics. Vane is of 316 stainless and fitted with a rubber seal when desired. Standard Rato-Vane valves, as they are



designated, are supplied with hand jackscrews, air-operated diaphragms, and valve positioners. They are designed for static line pressures up to 125 psi. and differential pressures up to 50 psi.

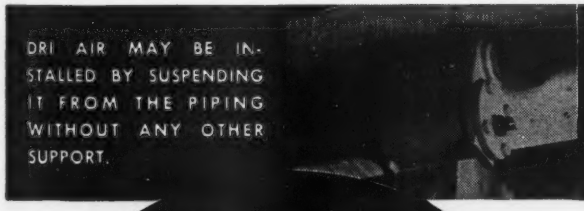
Every contractor can be a weather prophet says Dr. Irving P. Krick, president of the American Institute of Aerological Research, who has developed a pocket-size forecaster that is easy to use and is said to give accurate information about local conditions 12 to 24 hours in advance. It is designed on the basis that weather is caused by certain moisture and temperature conditions in the atmosphere; not alone by changes in air pressure. The user notes the direction of the wind and the formation of the clouds and examines seven pictures on the face of the instrument to find the matching formation. Then he turns a dial to point an arrow in the direction of the wind and, presto, the weather prediction appears in a window in the top of the forecaster, which is being manufactured by the American Optical Company.

Magnesium offers numerous advantages over steel as a material for concrete wall forms and is being tested for that purpose. Panels can be easily handled because they weigh less than 3 pounds per square foot, do not rust, are little affected by temperature changes, and are highly resistant to the corrosive action of the alkalies in concrete. Made of $\frac{3}{16}$-inch plate, the surface obtained is smooth—free of waves and dents that require rubbing or patching.

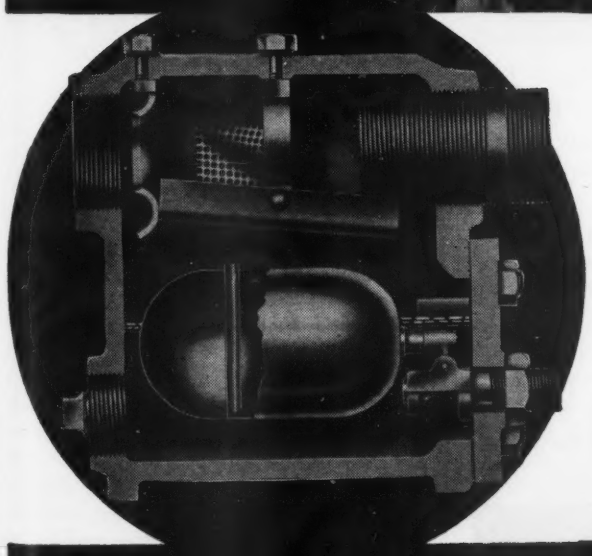
Horizontal movement of extra-heavy loads is made easy by a new roller-conveyor top built for use in connection with Hamilton Tool Company's Portelvator, a portable table with 4-point support and three table surfaces which is designed for elevating and transporting tools and materials. The conveyor fits snugly on top of the table, and is held in place by an encompassing flange. It may be installed or removed, as required, without tools—by simply lowering it into or lifting it from position. A wedge inserted between rollers at each end of

the load prevents the latter from slipping during transit. In addition to the top shown, there is one with rollers mounted at the ends. Either style can be furnished with a cam-operated roller locking device.

Householders burning fuel oil may be interested in a product developed by Shell Company that is an ingredient in



INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR



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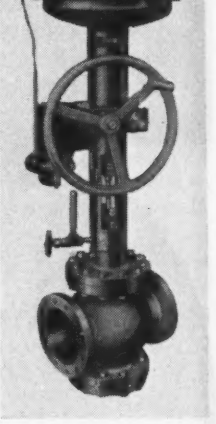
all domestic heating oil processed in its refineries for the 1949-50 season. Designated as FOA-5X, it is said to prevent oil-burner failure through clogged filters.

Nylon in powder form, which has a heat resistance of 380°F., will soon be available in seventeen colors for molding nuts, rivets, gears, etc.

Solder is being preformed to customers' requirements by Kester Solder Company primarily for repetitive work. Each ring, washer, pellet, or other shape in a given lot contains the same amount of solder and flux and therefore insures uniform results with minimum wastage.

If you are worried about snow and ice on your shingled roof, get a Rockbestos de-icing kit. It contains 60 feet of lead-sheathed heating cable with an electric plug and clamps for holding the line in place. When laid around the edges in a series of loops extending well above the intersection of the roof and inner wall, the heat melts channels in the ice that act as drains and prevent water from backing up under the shingles and leaking down inside to ruin brick and plaster.

Conventional by-pass installations in air lines are said to be unnecessary with the new Hammel-Dahl Continuously Connected Handwheel Control Valve. In the past, diaphragm control valves have been placed in the main run of piping with a block valve up as well as downstream from it. A globe valve, the same in body size as the control valve, was installed in the by-pass to permit manual operation should there be an interruption in the air supply, or should the control instrument fail. All this is eliminated by the Continuously Connected Handwheel, which is an integral part of the all-steel superstructure of the control valve. The handwheel is powerful enough to operate the latter, regardless of maximum instrument air pressure on the diaphragm or in opposition to the spring. It is claimed that the valve plug can be set by hand under any conditions by merely turning the handwheel to the required position. Valve characteristics are the same whether automatic or hand control is used. The full clearance window in the superstructure allows repacking or servicing of the packing box without disassembly.



Industrial Literature

A chart has been prepared by the American Brake Shoe Company of all welding rods and electrodes made by it for hard-facing operations and indicates the type of service for which each is designed. Metallurgical and physical descriptions also are included and arranged so as to help users select the right rod for every job. In addition, for purposes of comparison, it lists competitive rods and electrodes for each application covered. Requests for the chart should be sent to the company at 230 Park Avenue, New York 17, N.Y.

Recommendations on the selection and use of rust preventives are set forth in a pamphlet put out by Esso Standard Oil Company. It describes removable, nonmetallic coatings that serve as corrosion barriers in a variety of industrial applications. Emphasizing that the best protection can be insured only if rust preventives are chosen with the jobs in mind, the booklet gives detailed information on their proper selection as well as on their use. A copy will be sent upon request to the company at 15 West 51st Street, New York 19, N. Y.

Carbon and alloy steels for making castings are described in a 16-page booklet put out by Dodge Steel Company, Philadelphia 35, Pa., and obtainable upon written request to the company. Materials covered vary from normal carbon steel to various combinations of chromium, molybdenum, and other alloys. The publication is intended to serve as a guide in the selection of steels for casting purposes, as well as to provide data such as specifications, chemical and physical properties, etc. A brief description of the general applications of each metal is included.

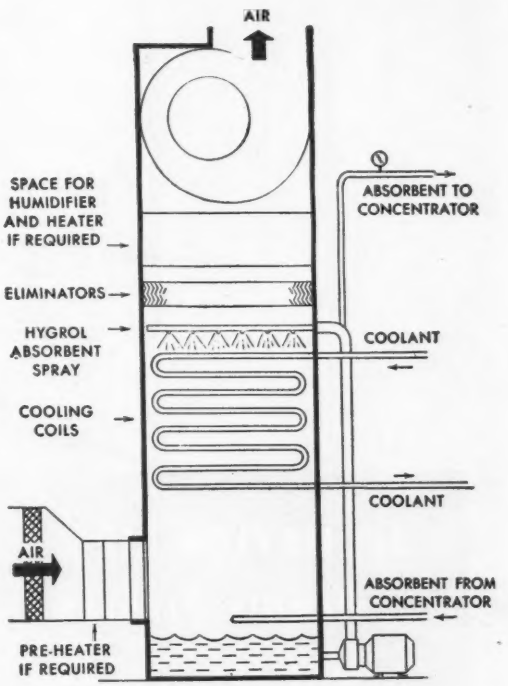
Design and application data on Fiberglas materials for the thermal and acoustical insulation of ducts and duct systems is contained in a booklet obtainable from Owens-Corning Fiberglas Corporation, Toledo 1, Ohio. It describes each of the available types and also gives information on weight, thermal conductance, sound absorption, moisture affinity, corrosion, and resistance to fire, air erosion, weathering, and temperature. A section of the publication is given over to detailed and illustrated accounts of methods by which the insulation is applied to exteriors and interiors of ducts of all kinds.

Bulletin 14B7274 of Allis-Chalmers Manufacturing Company describes oil-immersed, wall-mounted motor starters of the full-voltage type. The units are designed for the control of squirrel-cage motors of 350 hp. or less at 2300 volts alternating current, as well as for the primary of wound-rotor motors of the same class. Built for ease of installation and inspection, they are completely sealed and weatherproofed for outdoor use. The entire starting mechanism is immersed in oil and sealed from the atmosphere as a protection from corrosion and a safeguard against sparks. A copy of the bulletin can be obtained by writing to the company at 1000 South 70th Street, Milwaukee, Wis.

Technical data on tool and high-speed steels is contained in a 16-page booklet obtainable from Allegheny Ludlum Steel Corporation, Pittsburgh 22, Pa. One of a series, which deal with the properties of each kind of steel the company produces, the publication gives information on various grades of steel summarized from carefully checked laboratory and service tests. Be-

New Method Gives Precise Control in Air Conditioning

Niagara "Controlled Humidity Method" Uses Hygrol, Hygienic Liquid Absorbent

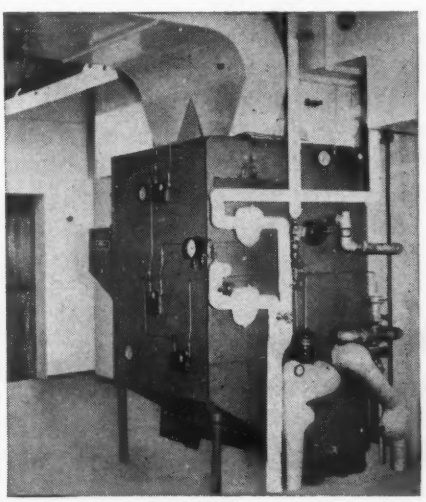


NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

● The Niagara "Controlled Humidity Method" is a new system of air conditioning giving complete control of temperature and relative humidity, holding constant conditions or varying them at the will of the user. Especially, it provides dry air at normal atmospheric temperatures with little or no refrigeration required. A condition of 15 grains of moisture per pound of air at 85 deg. F. dry bulb temperature has been produced without refrigeration.

The apparatus is enclosed in a casing thru which the air is drawn by fans. The air is filtered and then enters a chamber where it is dehumidified in passing thru a spray of "Hygrol" Liquid (a hygienic hygroscopic chemical that absorbs the air-borne moisture and contains no salts or solids to precipitate). In the same chamber are located cooling coils which remove the latent heat of evaporation and also sensible heat as required.

The absorbent liquid spray falls into a tank at the base, where it is piped to a concentrator, removing moisture taken from the air. The re-concentrated liquid returns to the system. This process is continuous, and the apparatus operates at full capacity at all times.

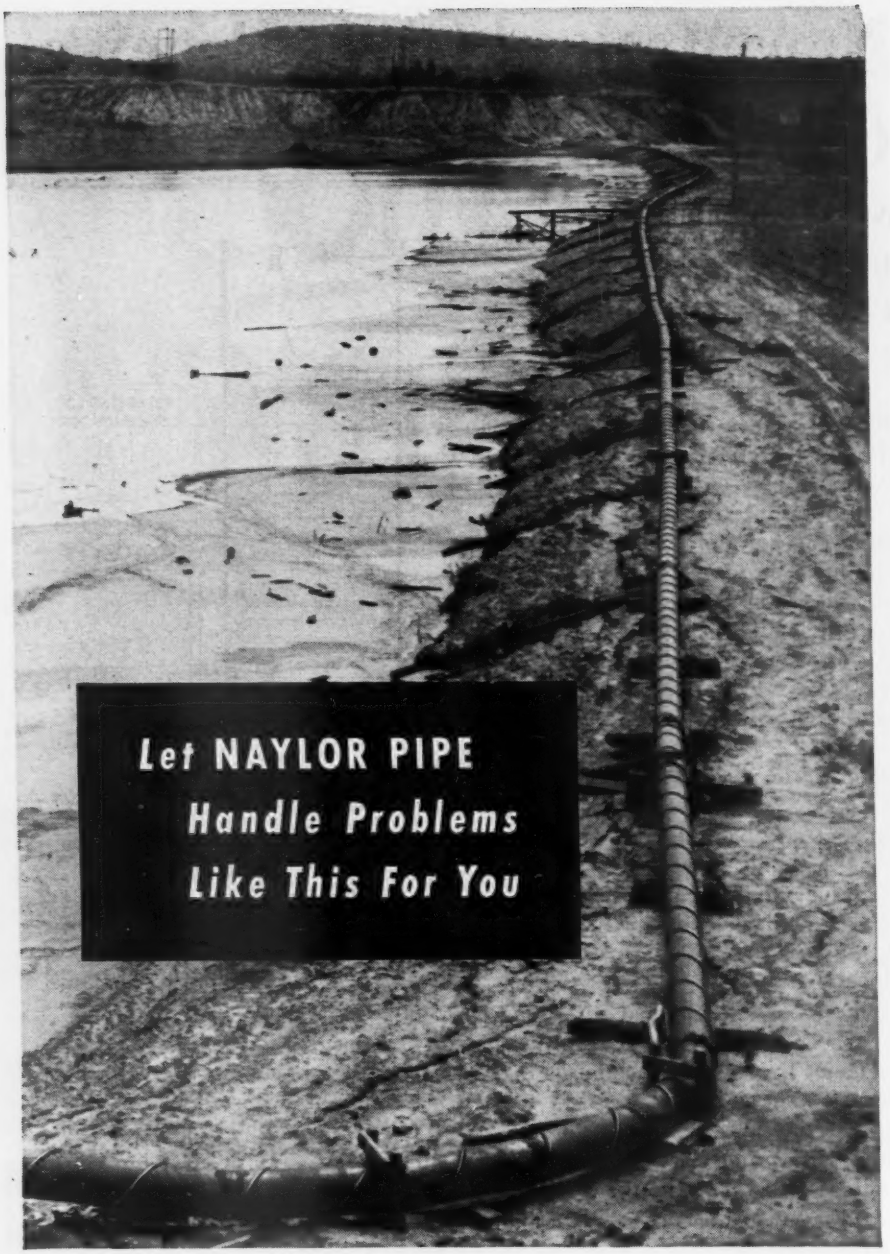


The same equipment may be used to provide winter air conditioning when required, by installing a tempering coil at the outdoor intake, an humidifier, and a reheat coil above the eliminators.

This equipment is manufactured in a range of sizes providing from 1000 to 20,000 CFM of conditioned air from a single unit, and mutiple unit installations are practical. It is expected that, by reducing the need for refrigeration, the cost of air conditioning will be reduced by this method. Applications generally are in a temperature range from 35 deg. F. upward. Below the freezing temperature of water, the Niagara "No-Frost" method is applicable.

The equipment is protected by U. S. and foreign patents. Installations have been made in food and chemical process industries, in packaging hygroscopic products, for preventing condensation of moisture on metals and other products in storage, in air conditioning for laboratory control and for human comfort.

For further information, write Niagara Blower Company, Dept. CA , 405 Lexington Ave., New York 17, N. Y.



The tailings line shown here is typical of the way Naylor pipe fits into the mining picture. Naylor is the lightweight pipe with the exclusive Lockseam Spiralweld structure that makes it stronger and safer than other lightweight pipe. It's the practical, economical answer in mining service on high and low pressure water lines, air lines, hydraulicking, ventilating, suction lines, sludge lines, drainage as well as tailings lines. Sizes range from 4" to 30" in diameter—thickness from 14 to 8 gauge—all types of fittings, connections and fabrications. For details on Naylor Pipe and Naylor Wedge-Lock Couplings, write for Catalog 44.

NAYLOR PIPE COMPANY
1245 East 92nd Street, Chicago 19, Illinois
New York Office: 350 Madison Avenue, New York 17, N. Y.

ginning with a simple chart that enables the user to select the steel best suited for the job in mind, the booklet continues with procedures and tabulations that form a working manual for makers and users of cutting tools and dies. Some of the many subjects covered are design practice, machining, cutting-tool angles, speeds, heat-treating, and grinding.

Industrial concerns wishing to promote eye safety among their employees can obtain helpful information in the form of a booklet issued by the American Optical Company, Southbridge, Mass. Containing data based on practices introduced in some of the country's largest plants, the publication tells how to establish a program of eye safety through the use of prescription-ground goggles. It explains methods by which such a program can be set up, how the necessary professional services can be secured, and how it should be operated to derive maximum benefit. It also gives step-by-step instructions on the use of a prescription order book supplied by it to industrial concerns.

Brown Instruments Division of Minneapolis-Honeywell Regulator Company has prepared a catalogue that describes its line of mercury-type switches. Intended for electrical switching in industry, the switches consist of two basic types: mercury-to-electrode and mercury-to-mercury. Typical applications include radios, safety controls, burglar alarms, refrigeration controls, business machines, textile and paper machinery, pumps, aircraft controls, water systems, etc. Several pages of engineering data, as well as selection tables and complete switch specification charts, are included in the booklet, a copy of which may be obtained from the company at Wayne & Roberts Avenues, Philadelphia 44, Pa.

According to General Electric Company, modern industry can benefit from properly applied adjustable-speed motors and motor drives. To back up its claims the firm has issued five booklets that give case histories—show how such motors have stepped up production, made machines more adaptable, and helped turn out better products. They also list the various packaged units available, their range of application and their performance features; their advantages, operating characteristics, and ratings; and the points to consider when selecting adjustable-speed drives. Equipment covered includes alternating- and direct-current motors, packaged drives, and various electronic devices that provide adjustable speed for motors. Copies of the publications can be obtained from the company at Schenectady 5, N. Y.

Equipment for the petroleum-refining industry is described and illustrated in a 20-page catalogue put out by Black, Sivalls & Bryson, Inc. The publication covers large pieces of equipment such as heaters of indirect, tubular, volume, and internal-firebox types; separators, both vertical and horizontal models; gas scrubbers; dehydrators, both glycol- and solid-desiccant types; and safe-walks—packaged all-steel, prepunched and precut units for making walkways, stairways, loading racks, platforms, docks, etc. Also mentioned are safety heads, combination safety heads and relief valves, combination vent valves and flame arresters, fuel vaporizers, low-pressure tanks and propane bulk-storage tanks, chemical feeders, blow cases, mufflers, pipe half soles, and special fabrication units. A copy of the publication can be obtained from the company at 720 Delaware Street, Kansas City 6, Mo.

Cut pressure losses with 50% lighter air hose

New B. F. Goodrich Highflex hose cuts weight, adds flexibility

NO MORE big pressure drop from compressor to tool, because of using a "too small" i.d. hose in order to get flexibility. New B.F.Goodrich Highflex air hose weighs 50% less than ordinary air hose of the same size, has greater flexibility. It allows the use of adequate-size hose to prevent excessive pressure drop; yet without sacrifice of a light, flexible line.

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Higher flexibility — With Highflex, workers can more easily work in close quarters. They tire less easily, can increase production.

High working pressure — Highflex has a rating of 250 lbs. working pressure. Single ply, double braid construction. Low expansion under pressure, minimum contraction of length.

Completely oilproof — Properly lubricated tools last longer. With Highflex hose you can lubricate without fear of oil causing hose to swell or flake, to cut air volume or jam the tool. Dragging Highflex through oil won't harm the cover.

More features — A red cover of high visibility makes Highflex easy to keep in sight. Cover resists checking, snagging, and abrasion. Its lighter weight takes up less room when stored. Ask your BFG distributor to show you this new air hose. *The B.F.Goodrich Company, Industrial and General Products Division, Akron, Ohio.*

Air Hose
BY
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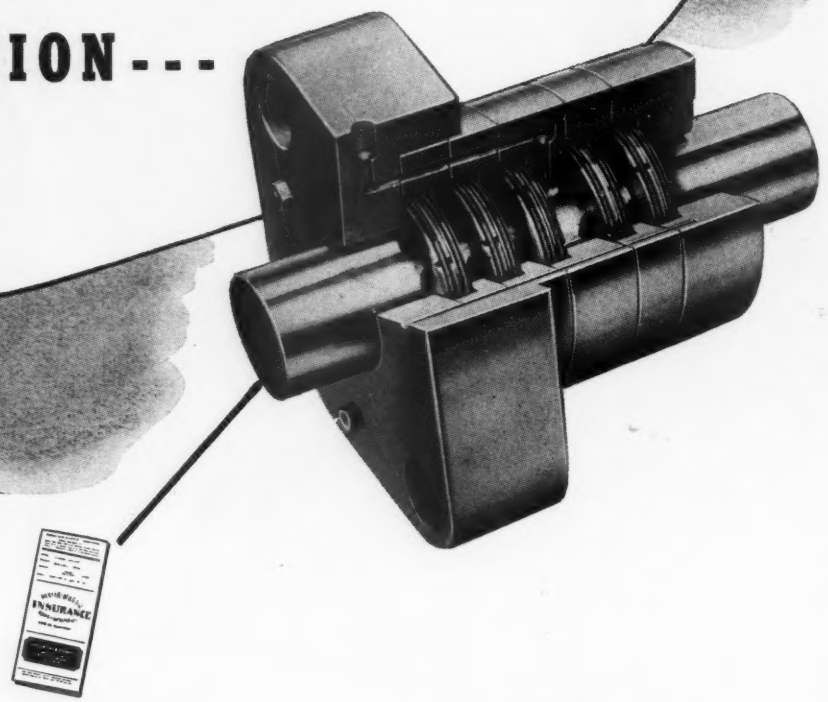
BETTER PACKING FOR MORE EFFICIENT RESULTS—THROUGH METALLURGY

INSURANCE FOR LONG, TROUBLE-FREE OPERATION---



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It will pay you to take full advantage of everything this "performance insurance" offers you. For instance, if repair parts are ever needed you can always get speedy service on "performance insured" replacements. Cook stocks an extensive selection of packing and ring designs and materials for all operating conditions. Emergency shipments can be made in a matter of hours from warehouse stocks in Louisville and in the Mid-Continent and California territories.

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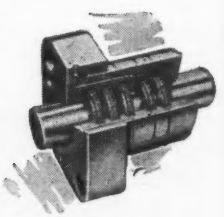

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